

SCIENTIFIC THEORY AND RELIGION



SCIENTIFIC THEORY AND RELIGION

The World described by Science and its Spiritual interpretation

by

ERNEST WILLIAM BARNES

Sc.D. Camb., Hon. D.D. Aber. and Edin., Hon. LL.D. Glas., F.R.S., Bishop of Birmingham

THE GIFFORD LECTURES AT ABERDEEN 1927-1929

CAMBRIDGE
AT THE UNIVERSITY PRESS
1933



CAMBRIDGE UNIVERSITY PRESS Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo

Cambridge University Press
The Edinburgh Building, Cambridge CB2 8RU, UK

Published in the United States of America by Cambridge University Press, New York

www.cambridge.org
Information on this title: www.cambridge.org/9780521730228

© Cambridge University Press 1933

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 1933
This digitally printed version 2008

A catalogue record for this publication is available from the British Library

ISBN 978-0-521-73022-8 paperback



CONTENTS

\mathbf{F}	FOREWORD page xxiii		
		LECTURE I. INTRODUCTION	
§	1.	Jewish cosmology	1
		The different picture created by modern science	2
	3.	Repercussions of scientific progress: free-will: invariable	
		sequence	2
	4.	The constant progress of science constitutes a series of	
		ever closer approximations to the truth	4
	5.	Theology cannot be based solely on human spiritual ex-	
		perience: it must take account of the God of Nature	
		revealed by science	5
	6.	The philosophical assumption of these lectures is a	
		moderate realism: the physical world exists inde-	
		pendently of any human mind	6
	7.	The external world a somewhat unexpected synthesis	
		gradually being constructed by the observation and	
		thought of humanity	7
	8.	Rational and irrational faith	9
	9.	The limitations of scientific knowledge	10
1	0.	The opportunity of superstition	11
	1.	The laws of Nature	12
1	2.	The range of the lectures	13
		LECTURE II. MATTER	
1	3.	The physicist's definition of matter: inertia	14
1	4.	The Galilean principle of inertia an experimental fact	14
	5.	Matter in ancient speculation	15
1	6.	The nature of combustion	16
1	7.	The law of 'conservation of matter'	16
1	8.	Force	17
1	9.	The implications of Newton's second and third laws of	
		motion	17
2	0.	The law of conservation of energy	18
	1.	Mass and weight: inertia and gravity	18



Vi	CONTENTS	
§ 22.	Einstein's revolution: energy has inertia page	20
23.	Dalton's atomic law	21
24.	Atoms: their existence and size	22
25 .	Mendeléev's Periodic Table	25
26.	Atomic number and the true order of the elements	26
	LECTURE III. SPACE	
27.	Our intuitions of space and time	28
28.		28
2 9.	The arbitrary separation of space from time	30
30.		30
	Coordinates: three-dimensional space and its numerical	
	representation	30
32.		32
	Consideration of Lobatchewskyan or hyperbolic plane geometry	34
34.	•	34
35.		35
36.		99
	mental congruence theorem associated with them	36
37	The line-element in hyperbolic geometry	38
38.		38
39.		39
40.		00
20.	circle	40
41.		41
42.		42
43.		44
44.		44
	Riemannian plane geometry is, in effect, that of a sphere	45
46.		
	the basis of geometry	46
47.	The idea of space as homogeneous, isotropic and unbounded	47
1.8	The two sub-groups of rotation which exist for all types	T (
жо.	of space	47
49.	1 1 0 1	48
50.	"If there were no solid bodies we should not have geo- metry"	49
	₹	



CONTENTS

vii

LECTURE IV

RIEMANN'S GENERAL THEORY OF SPACE

Ş	51.	Introduction	page	51
•	52.	Intrinsic geometry of a surface	1 0	52
	53.			53
	54.	The line-element in Riemann's generalised space		53
		Geodesics of a manifold		55
	5 6.	Outline of Riemann's investigation		55
		The measurement of angles		5 8
	58.	Parallelism with respect to a surface		5 9
	5 9.	Infinitesimal parallel displacement		5 9
	60.	Such displacements satisfy the parallelogram rule		62
	61.	The extension to <i>n</i> -dimensional manifolds		63
	62.	Parallel displacement round an infinitesimal parallel)-	
		gram		64
	63.	The Riemann-Christoffel tensor		66
	64.	Sections of a manifold and the change in a vector after		
		describing an infinitesimal circuit lying in a give	n	
		section. Pérès' formula		74
	65 .	The total or Gaussian curvature of a two-dimensions	al	
		surface		76
	66.	Use of geodesic surfaces to determine the curvatures of	of	
		an <i>n</i> -dimensional manifold at an assigned point		79
		The condition that generalised space should be flat		80
	68.	Application to our three-dimensional space and t	ю	
		similar <i>n</i> -dimensional manifolds	_	81
	69.	The canonical form for the line-element in generalise	d	
		space of constant curvature		83
	70.	Some transformations of the canonical form for three	e-	
		dimensional space		87
	71.	A geometrical interpretation of three-dimensional space	ee	00
	***	of constant positive curvature		88
	72.	Canonical forms for homogeneous and isotropic three	9-	00
	2 0	dimensional space		88
		The true range and value of Riemann's achievement		89
	14.	The nature of the space of common experience in the	ie	OΛ
		light of Riemann's analysis	a	90
		Résumé of properties of (1) Euclidean, (2) hyperbolic an	ıa	00
		(3) spherical space		90



viii	CONTENTS	
75.	The analytical investigation of plane hyperbolic geo-	
,		ge 92
76.	Lobatchewskyan geometry of the plane is that of the	
	pseudo-sphere in Euclidean space	93
77.	The volume of Lobatchewskyan space	93
78.	Riemannian geometry of the plane is that of the sphere	
	in Euclidean space	94
7 9.	The volume of spherical or Riemannian space of three	
	dimensions	94
	Properties of Riemannian space	96
81.	To which of the three possible types does our space belong?	96
	LECTURE V	
\mathbf{SP}	ACE-TIME: THE SPECIAL THEORY OF RELATIVI	\mathbf{TY}
82.	The measurement and interconnection of space and time	98
83.	_	99
84.	Does absolute rotation exist? The views of Newton and	
	Mach	100
85.	The belief in absolute chronometric time	101
86.	The belief in absolute simultaneity	103
87.	Two fundamental enquiries	103
88.	The Michelson-Morley experiment	104
89.	The fundamental result of the special theory of relativity	105
90.	The restricted principle of relativity	107
91.	The Fitzgerald-Lorentz contraction	108
92.	The equations of the Lorentz transformation	109
93.		110
94.	The Lorentz transformation for infinitesimals	112
95.	Time-measurements in the special theory of relativity	112
96.	<u> </u>	114
97.		116
98.	Geometrical illustration of the way in which different	
	observers break up the space-time continuum	117
99.		119
100.	Weyl's picture of 'the scene of reality'	122
101.	Composition of velocities according to the special theory	
	of relativity	122
	Fizeau's experiment	123
103.	The fundamental definitions of the mechanics of the	
	special theory of relativity	123



	CONTENTS	ix
§ 104.	The fundamental law of kinetics, and its transformation	
		ge 126
105.	Minkowski's world. Time and proper-time. The 'four-	
	velocity' and 'four-acceleration' vectors	126
106.	The fundamental dynamical equations of the special	
	theory of relativity	128
107.	The equivalence of mass and energy	131
	LECTURE VI. GENERAL RELATIVITY	
108.	The fundamental limitation of the special theory of	
	relativity	134
	The 'reality' of centrifugal forces	134
	Does absolute rotation exist?	134
	The equality of inertial and gravitational mass	135
112.	The likeness between gravitational and uniformly accelerated regions	136
113.	The passage from the special to the general theory of	100
	relativity	136
114.	The type of mathematical analysis needed in the	
	general theory of relativity	137
115.	Riemann's symbols and other tensors deducible there-	
	from	138
	Divergence. Covariant differentiation	142
117.	The fundamental identities of the general theory of	
770	relativity	147
118.	The stress-tensor at a point in a continuous material	
110	medium	148
	The Newtonian equations of motion in such a medium	150
	A symmetrical form for such equations	151
141.	A modified form of these equations in which time has not a privileged position	1 50
199	The energy-momentum-stress tensor	152
	The connection between mechanics and geometry	154
	Einstein's gravitational equations of the general theory	159
T. W. I.	of relativity	160
125.	· · · ·	100
120.	neither matter nor energy	161
126.	The justification of Einstein's gravitational equations	166
вят		b



x	CONTENTS	
§ 127.	The problem of two bodies is insoluble in Einsteinian	
	dynamics page	169
128.	The gravitational field of an isolated particle	170
129.	Einstein's equations for the orbit of a planet moving	
	round the sun	172
130.	The motion of the perihelion of Mercury	173
131.	The bending of rays of light near the sun	174
132.	The spectrum-shift due to a strong gravitational field	176
133.	Gravitation is due to the warping of space-time	177
134.	The law of gravitation is a disguised identity	178
135.	Our measures of matter and momentum are determined	
	by the warping of space-time	178
136.	The position of the law of conservation of energy in	
	Einsteinian mechanics	180
137.	Is space finite?	183
138.	The objection to a Newtonian-Euclidean cosmos	184
139.	Einstein's time-cylindrical cosmos	184
140.	de Sitter's cosmos	187
141.	General relativity and the Maxwell field-equations	189
142.	Conclusions and speculations	190
	recomine wit	
	LECTURE VII	
	THE ELECTRICAL THEORY OF MATTER	
	Electricity and magnetism: the original discoveries	193
144.	Maxwell's achievement	193
	Electricity and matter	193
	Coulomb's law. What is electricity? Electrons. Ions	194
147.	The nature of an electron	197
	Radiation	200
149.	The inertia of an electron	202
	The ether	202
151.	The inertia of light	204
	The energy of matter	204
	Can we create electrons?	205
	X-rays: origin: properties and spectra	206
155.	The radio-active process: and the law of radio-active	
	decomposition	207
156.	The age of the earth	209
157.	The puzzle of uranium	210



	CONTENTS	хi
§ 158.	The products of radio-active disintegration: and the	
	nature of the process page	211
159.	The electrical constitution of matter	212
	The ordering of the elements	213
161.	The sizes of atoms, electrons and protons	215
	Bohr's model of the atom	217
163.	Chemical combination	219
	Isotopes	219
165.	The spectrum of an element and its origin	221
	A comparison with the solar system	222
	The spectrum of hydrogen	222
	Perplexities due to the Bohr model	223
	Is free-will possible in inanimate nature?	224
170.	Some further enquiries	225
	LECTURE VIII. HEAT AND LIGHT	
171	Heat and change of state of hodies	227
	Heat and change of state of bodies Pressure and temperature	227
	Boyle's law: Charles' law	228
	The graduation of an air thermometer	229
	Absolute zero	229
	Work done by an expanding gas	230
	The first law of thermodynamics	231
	The character and origin of the second law of thermo-	201
110.	dynamics	231
179.	Carnot's reversible engine	231
	Carnot's principle and efficiency function	232
	The absolute (Kelvin) scale of temperature	233
	An expression for the efficiency of a reversible engine	234
	The indicator-diagram for Carnot's cycle. Isothermals	
	and adiabatics	235
184.	Entropy: must increase with spontaneous change in a	
	physical system	236
185.	The two fundamental principles of thermodynamics	237
	The nature of entropy	238
	Entropy and the direction of time: the end of the Uni-	
	verse	238
188.	Light: an electro-magnetic phenomenon	240

b 2



XII	CONTENTS	
§ 189.	The polarisation of light page	242
	The intensity of radiation: radiation pressure: comets	
	and their tails	242
191.	The Doppler effect	244
	Isotropic radiation	246
193.	Equilibrium of radiation: the balancing of absorption	
	and emission	247
194.	Black-body radiation	249
195.	Radiation from the sun and stars: from planets: within	
	a star	249
196.	Absorption lines	251
197.	Stefan's law	253
198.	Planck's law	254
199.	Visual magnitudes and Fechner's law	255
200.	Measures of magnitude: absolute magnitude: the	
	Purkinje effect	256
201.	Radiation and human sight	258
	T D CONTINUE YOU	
	LECTURE IX	
	THE QUANTUM THEORY AND RÖNTGEN RAYS	
202.	The first form of the quantum theory	261
203.	The photo-electric effect	262
204.	The connection between energy emitted by an atom	
	and the frequency of the radiation produced	263
205.	The generalised form of the quantum theory: action is	
	atomic	264
206.	Bohr's theory of the hydrogen spectrum	267
207.	Elliptic orbits for the hydrogen atom	269
	The periodic system of the elements	273
209.	Wave mechanics and the Born-Dirac calculus	275
210.	The Heisenberg uncertainty-relations	27 9
211.	The present state of the quantum theory. Lindemann's	
	speculations. The concepts of space and time	281
212.	Röntgen radiation: the two types	284
213.	The origin of characteristic X-rays	286
214.	The connection between such rays and the atomic	
	number of an element	287
215.	The K -, L - and M -series of spectral lines	288
216.	The interference of light	290



	CONTENTS	XIII
§ 217.	The diffraction of light: diffraction gratings page	e 2 91
218.	The direct passage of plane waves through a slit	293
219.	Theory of a plane transmission grating	295
220.	Diffraction by a crossed grating or lattice	297
	Diffraction by a space-lattice: equivalent to a series of	
	reflections	298
222.	Crystals	300
223.	The diamond	301
224.	Arrangement and Creative Activity	302
	Crystal measurements of, and by, X-rays	303
	The achievement of X-ray analysis	304
227.	General conclusions	306
	LECTURE X. THE SOLAR SYSTEM	
228.	Ancient speculation	311
	The rise and triumph of the heliocentric theory. Kep-	
	ler's laws	312
230.	Newton's fundamental assumption	313
231.	The members of the solar system	314
232.	The earth: its shape, size, density and mass	314
233.	The distance and size of the sun	314
234.	The sun's mass and density	315
235.	The planets in general	317
236.	Laplace's theory of the origin of the solar system	318
237.	The modern theory	318
238.	The origin of the earth-moon system	31 9
	The moon	320
	Velocity of escape	321
241.	Conditions of escape of a gas from a planet's atmo-	
	sphere. Atmospheres of moon, sun and earth	322
	Other worlds than ours	323
243.		324
244.	1	327
	The tides in theory and observation	329
246.	Tidal friction: the lengthening of the day: ancient obser-	
	vations: effect of tidal friction on the moon's motion	329
	The past of the earth-moon system: its future	333
248.	The end of the earth-moon system	334



xiv

CONTENTS

LECTURE XI

THE GALACTIC UNIVERSE AND THE GREAT NEBULAE

THE GALACTIC UNIVERSE

§ 249.	The 'fixed' stars	oage	336
250.	Instruments		336
251.	The interferometer		337
252.	Astronomical measures of distance		33 9
253.	The shape and size of the galactic universe		340
254.	The unity of the galactic universe		341
255 .	The distances of the stars		343
256.	The open and globular clusters		343
257.	The cepheid variables		345
258.	Giant and dwarf stars		346
259.	White dwarfs		348
260 .	Spectroscopic parallaxes		349
261.	The total number of the stars		350
262.	Stellar radiation		351
263.	The radiant energy emitted by the sun		353
	Radiation emitted by the stars		354
265.	Where does the sun's energy come from?		355
266.	Consequences of the annihilation hypothesis		356
267.	The motions of the stars		357
268.	Binary stars		358
269.	Visual and spectroscopic binaries		358
270.	The mass-luminosity relation		361
271.	Eclipsing binaries		362
272.	The contrast between visual and spectroscopic binari-	es	362
273.	The ages of the stars		363
274.	Moving clusters		364
275.	Star-streaming and differential galactic rotation		365
276.	Novae or temporary stars		368
277.	The future of stars, sun and earth		371
278.	The observing of the nebulae		372
27 9.	Galactic nebulae		372
	THE GREAT NEBULAE		
280.	The great nebulae: their number		374
	The shapes of the great nebulae: their spectra		375
282.			377



CONTENTS

§ 283.	The sizes of the great nebulae pa	ge	378
284.	The velocities of the great nebulae	_	37 9
2 85.	Lemaître's expanding (or contracting) cosmos		381
286.	The instability of the Einstein cosmos		384
287.	Geodesics in the Lemaître cosmos		384
288.	Pressure, density and mass in this cosmos		385
28 9.	The Doppler effect in this cosmos		387
290.	The present size of our cosmos: its mass		389
	Some general reflections. Man and the cosmos		392
292.	The probable origin of the cosmos: and of stars		395
293.	A final enigma		397
294.	Are there other planetary systems?		398
295.	The frequency of stellar encounters		398
296.	The number of planetary systems in regions of local		
	star-density		401
297.	Life elsewhere in the galactic universe		401
298.	Is the whole cosmos the home of intelligent beings?		403
2 99.	The final state of the cosmos		404
300.	Cosmic rays and the annihilation of matter		404
301.	Extrapolation and its risks		406
302.	Need we postulate Divine intervention?		408
	LECTURE XII		
THE	ORIGIN OF LIFE AND THE GEOLOGICAL REC	O	RD
	THE ORIGIN OF LIFE		
303.	The coming of life to the earth		411
304.	Geology and the origin of life		411
305.	The living probably emerged from the non-living		412
306.	Arguments in favour of 'spontaneous generation'		413
307.	'In the beginning'		413
308.	The three fundamental elements of organic chemistry		414

309. The preparation for life

merely convenient?

312. Primitive organisms: of one type or many?

313. Was the earth's initial covering of gases essential or

314. Does life's supposed origin give any clue to its nature?

310. The ascent to life

311. The first life

415

415

416

416

417

419

xv



xvi

CONTENTS

THE GEOLOGICAL RECORD

§ 315.	The rise of geological investigation	page	420
316.	Gaps in the geological record	- 0	421
	The ages of the different strata of the earth		421
318.	Measurements by radio-active decomposition		422
	The main geological formations		423
	The Archaeozoic era		424
321.	The Palaeozoic era		425
322.	The Mesozoic era		427
323.	The origin of the birds		427
324.	The early mammals		428
	The Tertiary era: its divisions		428
	Tertiary geography		430
	The destruction of species		431
	The history of the horse		431
	A mammalian slaughter		432
	Man's end?		432

LECTURE XIII

THE EVOLUTION OF PLANTS AND SEX

THE EVOLUTION OF PLANTS

331.	The similarity of animals and plants	434
332.	The most primitive plants	435
333.	Liverworts and mosses: club-mosses	436
334.	Spores and seeds	437
335.	Ferns and seed-ferns	437
336.	The great botanical eras	438
337.	The age of cycads: descent or independent evolution	438
338.	The last botanical transformation	440
339.	Mammals and angiosperms	441
	Dicotyledons and monocotyledons	441
	Change in the Tertiary era	442
	Conclusion	442
	SEX	
343.	The basal facts: secondary differences	443
	The reproductive cells	444
	Sexual fusion	445



	CONTENTS	xvii
§ 346.	The distribution of the sex-chromosomes: the two sexes	;
		age 446
347.	An alternative sex-mechanism	447
34 8.	Inter-sexes and super-sexes	448
349.	Parthenogenesis: haploid males and diploid females	
	Artificial parthenogenesis	451
350.	Ants, bees and wasps	452
	The termites	453
352.	The advance of social organisation among the bees	454
	Instinct and intelligence: the salt of life	456
354.	The Virgin Birth	457
	LECTURE XIV	
7	THE EVOLUTION OF ANIMALS AND MENDELIS	SM .
	THE EVOLUTION OF ANIMALS	
355.	Evolution and religious prejudice	459
	The nature of species	460
357-	360. The main arguments for evolution:	
	(1) The geological record	462
	(2) The evidence from embryology	462
	(3) The existence of useless organs	465
	(4) The geographical distribution of animals	467
361.	Missing links	469
	The origin of the vertebrates	470
363.	The transition to the amphibians and thence to the	e
	mammals	471
364.	The moral significance of the development of the herd	
	instinct	473
365.	Mind versus material protection	474
	MENDELISM	
	Mendel's work and its significance	475
	Mendel's fundamental experiment	475
	Mendel's first law	477
	The law of independent assortment	478
	Linkage-groups	479
371.	Morgan's restatement of Mendel's laws of inheritance	480
372.	Mutant characters	482



xviii	CONTENTS	
§ 373.	The contrast between Mendelian and blending in-	
		484
	Mutations in humanity	485
	The persistence of mutations in humanity	488
	Sex-linked defects	489
	Mental mutations in humanity	491
	Feeble-mindedness	491
	Insanity	495
	Lethal mutations	497
	Inbreeding	498
	Can dysgenic mutations be reversed?	498
	Mutations and short-wave radiation	499
	The sexual cycle in animals and plants	501
885.	Has the sex-mechanism arisen independently in	F07
000	animals and plants?	501
380.	The future of the evolutionary process	502
	Charles Derwin's achievement	
	Charles Darwin's achievement	504
	The fact of variation Fluctuation	505
	Natural selection	506 506
	How does variability arise?	508
	Weismann's position	509
	Criticisms of Lamarckism	510
	Dürken's experiments	511
	Johannsen's experiments: fluctuations are not inherited	512
396.	Further arguments against the inheritance of acquired	
	characters	514
397.	The raw material of evolution	515
398.	Genetic variation the vehicle of emergence	518
3 99.	Evolution the result of external creative activity	519
400 .	Is God's creative activity non-moral?	520
401.	Man and the cosmic process	522
402.	The sternness of God	52 3
403.	The genetic process and predestination	523



		CONTENTS	xix
		LECTURE XVI. MAN'S ORIGIN AND PAST	
ş	404.	Man's place among the Primates pag	e 525
	405.	The earliest Primates	52 5
	406 .	The development of the Primates	526
	407.	Man's emergence	527
		Where and when did man emerge?	52 8
		The Java ape-man	53 0
	410.	The Piltdown remains	53 0
		Pekin man	531
		Heidelberg man	532
		Neanderthal man	532
		The coming of homo sapiens	534
		The men and culture of the Reindeer Age	535
	416.	The differences between Palaeolithic and Neolithic	
		culture	537
		Iberians and Nordics	537
		The cradle of humanity	538
	41 9.		53 9
	420.	8	542
		The development of brain and speech	543
		The faint dawn of civilisation	548
		The Reindeer Age civilisation	544
		Characteristics of primitive religion	545
		Animism	5 46
		The practical nature of primitive magic and religion	546
		The relation between magic and primitive religion	547
		Primitive religion and totemism	54 9
	42 9.	The development of primitive religion	550
		LECTURE XVII	
	:	SCIENTIFIC THEORY AND THE 'REAL' WORLD	
	430.	Introduction	552
		Naïve realism: physical realism	558
		Individual experience	554
		Collective experience: public knowledge	555
		The synthetic activity of the intellect	556
		The Newtonian philosophy	557
		1 1 "	



$\mathbf{x}\mathbf{x}$	CONTENTS	
§ 436.	Space and time page	559
	Realism and Idealism: moderate realism: theism	562
	A possible cosmos of monads	5 66
43 9.	Cause	567
440.	Substance	570
441.	Phenomenalism	573
442.	Materialism and agnostic naturalism	575
	Mechanistic determinism	577
444.	The problem of consciousness: psycho-physical parallelism	580
445.	Freedom and natural law	582
	LECTURE XVIII	
	GOD AND OUR BELIEF IN HIS EXISTENCE	
446.	Scientific experience: general conclusions	586
	Experience and 'Spiritualism'	587
	The dualism of natural and supernatural rejected	588
449.	Emergence	5 90
450.	Purposiveness in emergence	592
451.	The existence of God	593
452.	The ontological argument and its rejection	594
45 3.	The cosmological argument	5 9 5
	The teleological argument	597
455 .	Faith in God	5 99
456.	The natural sciences and qualitative judgments	600
457.	Individuality, value and quality	601
458.	The rise of moral consciousness	601
45 9.	Ethical judgments	603
460.	The realms of Nature and of moral order	604
	The moral argument for God's existence	605
462.	The absolute values	606
	LECTURE XIX. RELIGIOUS EXPERIENCE	
	Normal religious experience	609
	Prayer	611
465.	Does God answer prayer?	612
	Conversion	613
467.	The psychology of conversion	614
468.	The value of conversion	615



		CONTENTS	xxi
Ş	469.	Conversion and 'fundamentalism' page	616
•	470 .	Mystical experience	617
		Illustrations of mystical experience	619
		The 'dark night of the soul'	621
		The worth of mystical experience	623
		Induced experience	624
	475.	The problem of public worship	626
	476.	Sacraments	626
	477.	The necessity for guided religious experience	628
		The revival of pagan sacramentalism	629
	47 9.	Religious degeneration	631
	480.	Religious ecstasy must be subject to morality and reason	632
	481.	Religious experience and dogmatic assertion	633
		The duty of religious teachers	635
		LECTURE XX. IMMORTALITY	
		Soul and body	636
		The resurrection of the body	637
		Man's decisive separation from the lower animals	638
	486.	The background of belief in immortality: pantheism	
		and impersonal immortality	638
		Spinoza and immortality	640
		God as the Absolute	641
		The rejection of Absolutist theories	642
		The self as Ego	643
		Christian theism and immortality	644
		Immortality and the conservation of values	646
		Pantheism and theism	647
		Immortality and time	650
	495.	Personality and the psycho-physical organism	652
		CONCLUSION	
		The present and the immediate future of religious faith	653
		The character of the lectures	654
	498.	The advance of knowledge	655
	499.	Here and hereafter	656
		Appendix	658
		Index	661



FOREWORD

In publishing these lectures I would first of all thank the Senatus Academicus of the University of Aberdeen for the honour which they conferred upon me in the year 1925 by inviting me to be Gifford Lecturer. To Sir George Adam Smith, the Principal of the University, I am indebted for many kindnesses both in connection with the lectures and on other occasions: of the hospitality which was received from Lady Adam Smith and himself, when the lectures were being delivered, most happy memories remain. There were many in Aberdeen who combined to make visits there enjoyable; and not least would I thank those who attended the lectures and made the lecturer feel that his labour in preparing them had not been in vain.

Of the lectures themselves I would merely say that, wide as is their range, they have an inner coherence. I trust that they express the attitude of the modern man of science who, as he hopefully makes theories, is aware of the limitations of his knowledge and also, in part because of his loyalty to truth, bears in mind the reality and the claims of the spiritual world.

Since the lectures were given they have been extensively revised and some recent developments of knowledge have been included.

Acknowledgments are, I trust, adequately made in the lectures. Of those now living in this country to whom I am specially indebted I would mention my old teacher, Professor E. W. Hobson, whose own Gifford Lectures I have constantly consulted, Professor S. Alexander and Professor J. S. Haldane. If Hastings Rashdall, lately Dean of Carlisle, had not died before his time, I would rejoice to say how much talks with him had helped me in my thinking. He and Fenton John Anthony Hort were, among those no longer living, the greatest men of the Modernist movement in English theology.



xxiv

FOREWORD

Finally, my wife has helped me with constant encouragement and criticism: and my secretary, Miss N. M. V. Owen, daughter of the late Bishop of St David's, has been unwearied in preparing clean type-script from rough and illegible manuscript. I am ashamed to recall how often certain passages have been recast without, from her, a murmur of complaint.

E. W. B.

BISHOP'S CROFT BIRMINGHAM November, 1932