A. Vibert Douglas Publications by title
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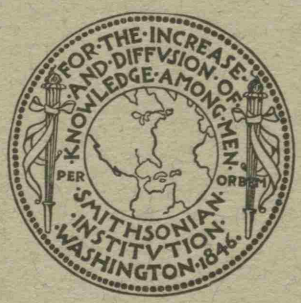
IMMENSITIES OF TIME AND SPACE

BY

A. VIBERT DOUGLAS, M. B. E., M. Sc.

FROM THE SMITHSONIAN REPORT FOR 1925, PAGES 147-155



(PUBLICATION 2838)

WASHINGTON
GOVERNMENT PRINTING OFFICE
1926

22nd September 1969
London 11
1008 Colborne Street.

Dear Dr Vibert Douglas.

I was delighted with your letter and should like to know if it is possible for you to come on November 24th at 8pm.

We shall certainly reserve a room for you and if you let us know by which train you arrive we'll be glad to meet you.

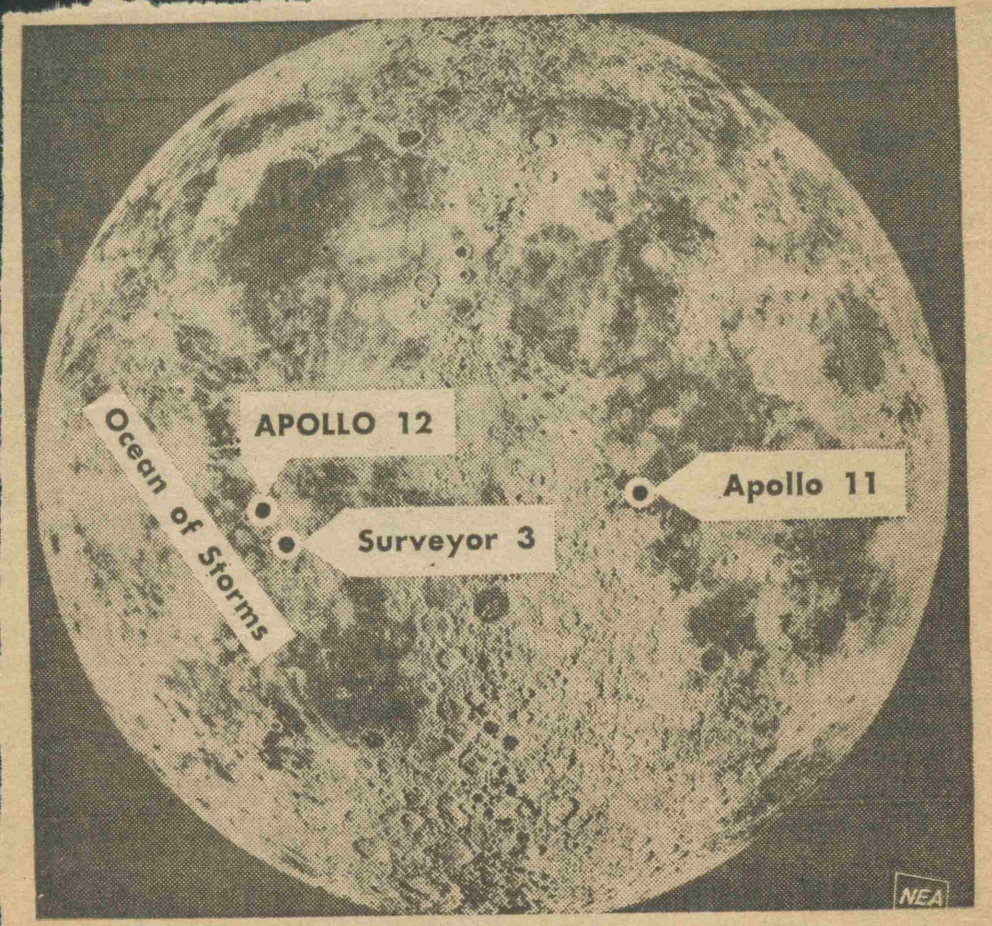
It may be interesting for you to see the new Telescope at the University & I'm sure Dr. Wehlau would enjoy showing you around.

One more request. Could you let me have a photograph, so we can put it in our brochure and would you please confirm the date as soon as possible

Sincerely yours,

Josephine Johnson
(Mrs Leonard N. Johnson)

R 25/9/69.



THE OCEAN OF STORMS, destination of the Apollo 12 landing team, is the broad plain half way across the moon to the west from the Apollo 11 touchdown point. Apollo 12 was aimed to come down a half mile or less from Surveyor 3, which soft-landed on the moon in 1967.

sive Americanization, and tells of the British-born woman who makes wire Yuletide sculptures.

TOKYO (AP) — Those who oppose it see possible disaster for Asia. Advocates predict a new era in Japan-United States relations. Whatever anyone says, Okinawa is expected to be back under Japanese rule by 1972.

Prime Minister Eisaku Sato is staking his political career and the life of his conservative, pro-American government on the outcome of this week's talks with President Nixon on the future of the former Japanese prefecture.

Okinawa was seized by the United States during the Second World War and developed after the 1949 Communist conquest of China into vast and powerful military bases supporting wars in Korea and Vietnam.

cannot continue once Okinawa becomes part of Japan, and agrees to subject the bases to the restrictions governing American bases in the Japanese main islands.

Bewildering to outsiders is the reaction of left-wing Okinawans and Japanese to Sato's mission to Washington. On the surface their objectives appear to be his: The return of Okinawa.

* * *

But the leftists' demands go far beyond Sato's. They want Okinawa returned immediately, not in 1972. They demand that neither American nor Japanese bases be there after reversion. More importantly, they insist that the security treaty—the document on which all U.S.-Japan military arrangements rest—be abolished.

The leftist parties on Okinawa and in Japan—the Socialists, Communists and Democratic Socialists—share these views in varying degrees.

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Queen's student dies in accident

NAPANEE — A one-car accident seven miles east of here Tuesday claimed the life of a second-year Queen's law student.

Dead is Thomas Peter Lake, 27,

Douglas Marvin acclaimed Wellington village reeve

WELLINGTON — Ameliasburg Township is not the only municipality which won't be having an actual voting election this year.

All of Wellington's six open
es have now been filled

cumbent councillors, and tw
newcomers to the scene, He
bert Hiles and Cecil B. I
sley.

The only person no
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5/11/65.

Astron ? 74-7 1965. Pulsars are galactic objects concentrated in the spiral arms. 36 objects plotted with concentration just below gal equator plane

Cf. J. Letters Oct '65. Ekers: Pulsars at 13 cm } both a steady and a fluctuating periodicity
Polarization linear or more generally elliptical varies from pulse to pulse.

Osborne The Universe QB 981 . S9 1962

no individ star is a strong radio source - diffuse gases in milky way + other galaxies

Reber 1944 Sag A (c. of galaxy) Cyg A Cas A + Canis maj discrete sources

Sky + Tel. May '65. p 290. Quasars - 1st Quasar. 1963. Australia - prog: Palomar
3C 273 in Virgo
class-like 12m.8
$H_\alpha H_\beta$ v. 5,5 high red shift.
H_α in infra red - O++ ~ Mg+
Quasars not seen in galaxies
optical point source.
often double radio source as much as 30 – 40 sec. apart
optical + radio variability
3C 273 also X ray source
optical chains < 0.5 sec arc.
radio chains < 0.002 sec arc.

model: v. dense compact nucleus. outer regions less dense + with relativistic electrons moving in mag field generating the non-Thermal continuum by synchrotron process.
? In core multiple super novae ?
? Coalescence of super nuclei ?

10/11/69.

Sky & Tel. June '69 p. 339.

Pulsars 1st identification Jan '69 One component of faint double star at centre of Crab Neb (Taurus) optical 30 times/sec radar 30 times/sec rocket obsns X rays 30 per sec

Compton Scattering X-ray polarimeter

Distances inexpressible by nos that have name
Milton

Behold the throne of chaos and his dark
pavillion spread, wide on the boundless waste.
Milton

Spacious as the starry firmaments inescapable
infinity of adriant gaze, that faileth only
as it out passeth mortal sight - Rob Bridges

Imagination goes forth in encircled glory
Blake

Life is a constellation, an influenced dark
strewn with starry moments.
Tagore

Look where the child of heaven skips down
the slanted sunlight of the dawn
Shelley

Look how the floor of heaven is thick inlaid
with patines of pure gold.

Millenniums a thousand fold
from the ancient hour of prime.

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IMMENSITIES OF TIME AND SPACE[1]

By A. Vibert Douglas, M. B. E., M. Sc.

Within the last twelve months three workers in the realms of mathematical astronomy and cosmogony have brought their researches to conclusions of tremendous importance and widespread interest. So closely are their problems interwoven that it may prove stimulating to consider in some detail the aim of each investigation, the line of argument, and the outstanding results thus far achieved.

STAR'S MASS AND LUMINOSITY

Last year there was given to the Royal Astronomical Society by Prof. A. S. Eddington, F. R. S., a paper which has aroused great interest among astronomers the world over. For many years Professor Eddington has been investigating the radiative properties of a giant star—that is, a star of gigantic size and low density, so low that it could be considered as obeying what in physics are known as the "perfect gas" laws. These investigations led him to the conclusion that the total luminosity of such a star depended chiefly upon its mass and temperature, being almost uninfluenced by other factors. To test the validity of this formula relating luminosity to mass, he first evaluated the constants involved in it from the known values of mass and luminosity of the bright star Capella. He then plotted his relation as shown in the accompanying graph by the curved line. Next he collected all the available data from every possible source, giving both the masses and luminosities of stars and these he plotted individually on his graph. Their close

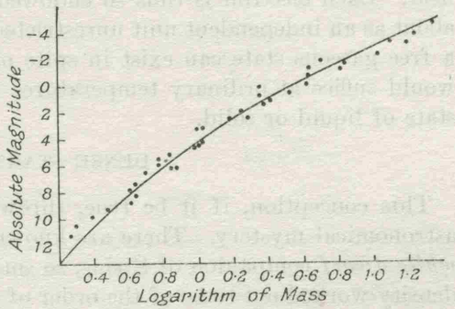

Fig. 1.—Diagram of luminosity—mass relation.

[1] Reprinted by permission from Discovery, Vol. VI, No. 68, August, 1925.

proximity to the theoretical curve is very striking, and forms a strong confirmation of the validity of the theoretical work.

Curiosity, we suppose, led him to wonder where the points would lie representing similar data for the dwarf stars. Now the dwarf stars were so named by Prof. Henry Norris Russell because they are so dense, due to gradual contraction, that it was thought impossible that the gas laws could hold true in their case. Hence a relation between mass and luminosity explicitly based upon strict adherence to the gas laws would not be expected to hold good for a star of the dwarf type. But, *mirabile visu*, the plotted points for data taken from dwarf stars conform as well to the theoretical curve as in the case of the giants.

This was an astounding fact suggesting as it did that the dwarf star, no matter what its density, was in the state of atomic agitation of a perfect gas. The explanation given by Eddington seems plausible, though it has not been accepted unanimously—namely, that where matter is subject to such high temperatures as exist in the stars, temperatures to be measured in millions of degrees, each atom is reduced in effective volume a hundred thousand times since its revolving electrons, whose outermost orbits determine its normal effective volume, are all stripped off or ionized by the intensity of heat. Each electron is thus so endowed with energy that it moves about as an independent unit unrestricted to any atomic orbit. Thus a free gaseous state can exist in spite of much closer packing than would suffice at ordinary temperatures to reduce the matter to the state of liquid or solid.

DENSE STARS

This conception, if it be true, throws light on a long-standing astronomical mystery. There are known to be a few stars, like the *white dwarf* companion of Sirius, so small yet so massive that their density worked out to be of the order of fifty thousand times that of water—an absurdity it was thought, an impossible result, something radically wrong somewhere in the observations or calculations. But instead of finding something wrong with the calculations, Eddington's work suggests that the trouble lay in our thinking the result absurd, in our failure to realize the tremendous difference between the state of matter at terrestrial temperatures and at stellar temperatures.

GIANTS AND DWARFS

If, then, all the stars are in a true gaseous condition, it is necessary to modify all ideas and calculations based on the old point of view that the dwarf stars were not obeying the same laws of pressure,

volume, and temperature as the giant stars. Prof. H. N. Russell's famous Giant and Dwarf theory of Stellar Evolution suggested that a star begins its career as a very large mass of gas, highly inflated and much less dense than air. This would slowly contract by gravitational influence, growing hotter and hotter and brighter and brighter. This period would embrace its life as a giant star.

When contraction had reached such a point that, upon the old view, the gas laws could no longer be considered as even approximately representing the state of the star, then at this critical point of balance between mass, density, and temperature, further gravitational contraction would of necessity be accompanied by decrease of temperature and of luminosity. This period constituted the dwarf stage of a star's career. Now this theory is thrown into a new light by Eddington's results. If the mass of a star be constant throughout

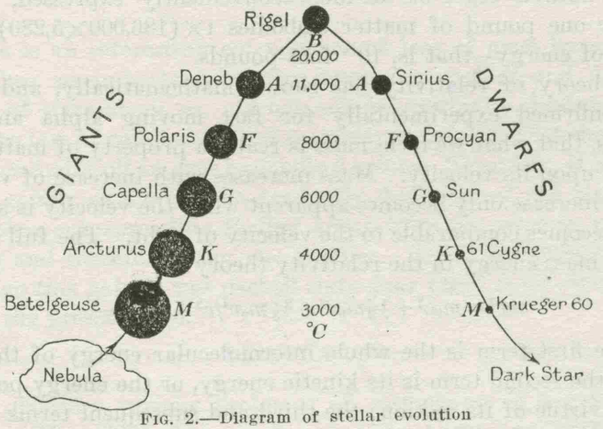

FIG. 2.—Diagram of stellar evolution

its life, Eddington's formula shows that there can be very little alteration in luminosity in spite of contraction, and hence the evolution of a single star as outlined above is an impossibility. If as an alternative interpretation the mass of a star is gradually diminishing, being actually consumed away to maintain the supply of energy which a star is continuously radiating, then Russell's theory of evolution may be retained as indicating the probable sequence of stellar change, but with this difference that, though the effective or surface temperature may decrease during the latter stages, the internal temperature will continue to rise.

LOSS OF MASS

A great deal thus turns on whether the mass of a radiating star can actually be considered to be diminishing. There are, furthermore, two ways of looking at this question.

One suggestion is that by collision of a very infrequent type between an electron and a proton (the ultimate particles of matter known to the physicist, carrying the unit electrical charges, negative and positive) their impact results in complete annihilation of their mass—that is, of the matter which they form—a definite amount of radiant energy being the equivalent result. This is highly speculative, there being no observed phenomenon in nature to prove definitely that such a transformation can take place; but it is theoretically possible, for matter and energy are essentially the same thing. Matter is one of many forms of energy and in the usual units of measurement of energy, the energy equivalent of a mass m grams of matter is $m\,c^2$ ergs where c is the velocity of light, 3×10^{10} cm. per second. In other words, one gram of matter represents a potential concentration of energy equivalent to nine hundred million million million ergs, or as more conveniently expressed, 9×10^{20} ergs; or one pound of matter embodies $1\times(186{,}000\times5{,}280)^2$ foot-pounds of energy—that is, 10^{18} foot-pounds.

The theory of relativity has shown mathematically, and it has been confirmed experimentally for fast moving alpha and beta particles, that what we term mass is really a property of matter that depends upon its velocity. Mass increases with increase of velocity, but this increase only becomes apparent when the velocity is so great that it becomes comparable to the velocity of light. The full expression for mass energy in the relativity theory is

$$mc^2 = m_0c^2 + \tfrac{1}{2}m_0v^2 + \tfrac{3}{8}m_0v^4/c^2 + \text{———}$$

Here the first term is the whole intermolecular energy of the mass at rest; the second term is its kinetic energy, or the energy possessed by it in virtue of its motion; the third and subsequent terms will be quite negligible for small values of the velocity v of the mass, but become appreciable one by one as the velocity v approaches the velocity of light. From this it follows that in order for the mass of a star to diminish as a result (or perhaps we should say as the cause) of its radiation, it is not necessary to postulate the annihilation of matter, but simply the loss in mass resulting from loss in velocity. From the above equation it can be seen that this might well be a tremendous reservoir of available energy.

The idea that continued stellar radiation might imply gradual loss in stellar mass was not new. It had been suggested some years ago by Dr. J. H. Jeans, but the facts above explained brought this idea forward with a new significance. Doctor Jeans saw that if this idea be really true, many astronomical problems are seen in a new light, and many investigations require reconsideration. This he has done and only recently has he published his results.

AGE OF SUN

One of the questions which has provoked controversy between geologist, physicist, and astronomer for many years is the probable age of the earth, an estimate of the age of the sun being, of course, an upper limit to the age of the solar system. Jeans attacks the problem from the new point of view, and his argument is as follows: The sun is radiating away its mass at the rate of about 4,200,000 tons per second and, if it were once as massive a star as Sirius now is, then it has been radiating for 7×10^{12} years. This means an age of at least a million million years, and is several thousand times greater than any previous estimate—a figure so great that it baffles comprehension, and staggers even the imagination.

GALAXY EXPANDING

There is an interesting consequence of loss of mass by radiation which has an important bearing upon our system and upon the galaxy of stars about us. If our sun be gradually diminishing in mass, the law of conservation of momentum requires that the planets move gradually off in ever expanding orbits. Similarly, if the mass of our galaxy as a whole be gradually diminishing, the stars must be opening out, spreading farther apart from the common center of gravity and therefore from one another. Jeans estimates that 10^{12} years ago this galaxy was packed sixty-four times more closely than it is at the present time.

BINARY STARS

This modifies various problems of cosmogony in a remarkable manner. The orbits of binary stars have long been a mystery, because no mutual force between two such stars was known which could account for their being in such eccentric and large orbits about their common center of gravity. Jeans points out that it is no longer necessary to look for such a force, that with the enlarged time scale for the galaxy (greater than 10^{10} years) outside influences become not only possible but very highly probable—that is to say, the normal orbits of a binary system may be perturbed by the gravitational pull of a passing star approaching more closely than is usual. The chance of such an influence being brought to bear upon a binary is greatly increased by the closer packing of the system in bygone ages. Basing his calculations upon the observed percentage of decidedly modified binary orbits and the probability of outside influence, Jeans obtains an estimate of the age of the galaxy which confirms his previous result of 10^{12} years.

permanence of star clusters, in particular, the great star cluster or galaxy near the center of which our solar system finds itself. Silberstein bases his calculations upon the four-dimensional space-time relations of de Sitter, and from this starting point he last year deduced a relation which could be evaluated in terms of observed astronomical data in such a way as to give a numerical value for an invariant characteristic of spacetime called by the mathematician the radius of curvature. This quantity, symbolized by R, has the finite value of 10^{12} astronomical units, that is 10^{12} times the distance from earth to sun. This theory, with the consequent value of R, has not been universally accepted, but this does not detract from the interest of the subsequent reasoning by which Silberstein deduces a criterion of stability in terms of the total mass of a system of material bodies (molecules or stars) and the radius of the system. Associated with any given mass there is a critical distance. If a star be at a greater distance than this critical value from the center of gravity, its orbit will of necessity be a hyperbola. This means that sooner or later it will desert the system forever. On the other hand, if its distance from the mass center be less than the critical value it will describe an elliptic orbit, thus remaining indefinitely within the system.

This criterion has been applied to those globular clusters far out in space beyond our own galaxy, for which the astronomer has been able to form estimates of their size and mass. They are found to be considerably less massive than our galaxy and very much more closely packed, so closely packed that the calculated critical radius is much greater than the dimensions of the clusters, which may, therefore, from the point of view of this theory, be considered as stable aggregates of stars.

The reverse is the case of our own galaxy. Much too widely scattered for its mass, its radius exceeds the critical value for stability, and therefore this theory predicts that it will suffer from what Doctor Silberstein terms "hyperbolic desertion" until its ranks be reduced and its volume diminished to such an extent that the criterion might perchance be satisfied. In its present form it is, like the Roman Empire, far too inflated to be enduring.

Densities can be treated in a similar manner. Silberstein evaluates the critical density of matter in space in terms of his finite curvature invariant R, the gravitational constant and the velocity of light—three fundamental quantities in this complex universe. Any aggregation of matter of less than this critical density will be unstable and tend to dissipate, whereas any aggregation of density exceeding this value will be in a state of stability. The galaxy of stars in which our system finds itself is estimated to have a density fifty-two times too small to satisfy the conditions for permanence.

Having surveyed the future, let us, in the light of this same theory, glance backward in an endeavor to trace the origin of a stellar cluster. Silberstein considers the possibility of a gaseous mass or nebula giving rise to millions of individual concentrations of matter, and thus forming the individual stars of a cluster. This was essentially the primary postulate of Laplace, though he was considering the relatively minute case of a nebula giving rise to a solar system—an impossible hypothesis in the light of modern knowledge. But as an explanation of the evolution of a small galaxy of stars, like many of the star clusters revealed by the telescope, it is by no means to be discarded—it may well be the true solution of the problem, as was pointed out by Jeans some years ago. When, however, an attempt is made to explain the origin of our galaxy in this manner, it is found to be incapable of satisfying all the conditions. Our galaxy, to quote yet another analogy taken by Doctor Silberstein from the history of mankind, must have developed, like the far-flung British Empire, by the aggregation into one conglomerate whole of many remnants of previous systems, systems long since scattered to the four winds.

Guided by some of the great thinkers of to-day, our thoughts have traversed æons of time, contemplating some of the changes taking place with majestic deliberation throughout the vastnesses of space. "Time rolls his ceaseless course." A million million years suffice for the birth of a star and its early development; a few hundred thousand years will tell the tale of the life of mankind upon this planet; and as for man, an individual man, the years of his life are three score years and ten, and yet such is the power of a great mind that, despite the brevity of its allotted span, it can wrestle with the problems of nature and learn something at least of the immensities of space and time.

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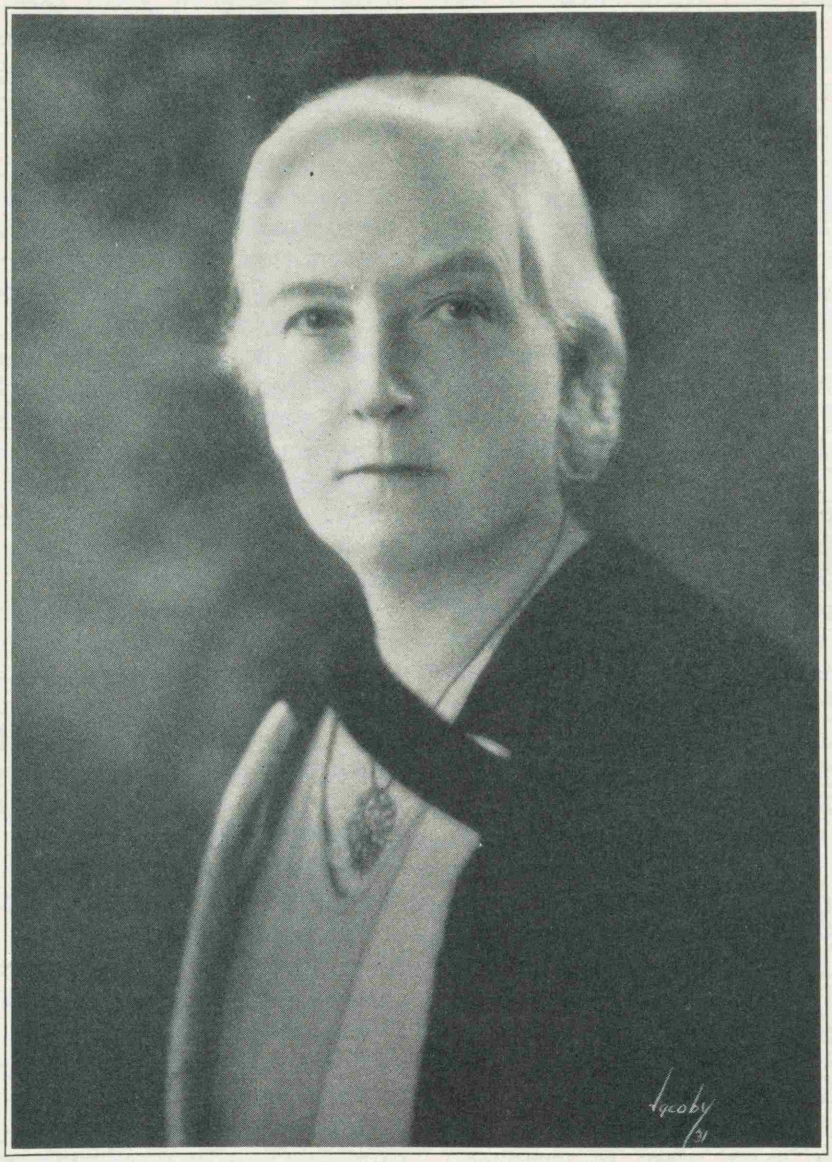

MISS HURLBATT

and "by indirections find directions out". Within the limits, then, of a refining but essentially savage north European story and Elizabethan drama, we think to see Hamlet as a neophyte Castiglionean at the very first, and an almost completed Castiglionean at the last. In between these two extremes are "Courtier" moods, exaggerated or violated so as to suggest the old form. Also there are moods wholly of the old and permanent beauty, such as the advice to the players. And there are some which indeed show a maturing courtiership such as the violent, redeeming harangue to the Queen (III iv).

To begin with minor matters—evident after the play opens—Hamlet is "our chiefest courtier." He dresses customarily in "solemn black." He affects the contemplative rather than the actional life, knows literature, music, and art. Yet he is skilled at fence and performs acts of singular daring with intrepidity. His prose is very natural to him, and the most "modern" in Shakespeare in the few moments when he is at ease. The tone and cadence can be judged from Ophelia's praise, and also from his own requirement of the players—"trippingly on the tongue." He uses puns habitually and with great skill as none of Shakespeare's other great ones does. He is a princely patron of the theatre, with precious notions about playing which must have seemed somewhat caviare to the general and public players whom he addresses. Coming toward greater matters, he is, or becomes, the really genuine and passionate friend, though proof of it is limited to a dozen precious lines to Horatio (III ii 68.). And coming toward the greatest, the controlling matter, he was a neo-platonic worshipper of beauty in nature, of which man is the perfect pattern, fixed in virtue where beauty is sure; subject only to the super-eminence of woman who is the priestess of this cult, unless she is the goddess.

Point by point these particulars can be paralleled from "The Book of the Courtier"—I give references to the Everyman's Library edition of Hoby's translation: "Therefore me thinke a blacke colour hath a better grace in garments than any other" (116). Princes should incline to the side of the contemplative life (280). Soldiership is a necessity and almost taken for granted, but war is nominated for glory not for gain, in the chivalric way which Hamlet applies to Fortinbras (70.) The Courtier must have special "skill in horses, and in whatsoever belongeth to a horseman" (41). Shakespeare could not endow Hamlet with this directly, but gives it to the Frenchman, Lamond (whose original seems to be Peter Mount of the *Book* 45); his horsemanship had witchcraft in it (IV vii 77-). The voice should be "shril, cleare, sweete and well framed with a prompt pronunciation, and with fit maners and gestures. . . not affected nor forced." Affectation, Hoby's "curiositie" is almost the worst vice, and helps explain why Hamlet between mean and extreme should all but go mad when he hears Laertes serenading the dead Ophelia. To hear him, at his best, "a man would weene nature herselfe spake to make them. . dronken with sweetness" (57). He must know how to use the retort courteous and abrupt, puns, innuendo within limits, ambiguous turns, and unexpected replies: they are the pith of speech (134-164). His patronage of the theatre passes the limits of this essay to discuss; it is expected, but not particularized. Yet there are particulars of palace conversation. And these Hamlet has followed, at the foot of the letter, bestowing them upon actors whom it is his Courtier duty to patronize. Finally, the Courtier idolizes man. "Thinke now of the shape of a man, which may be called a litle world. . . and then the forme altogether most beautifull. . . And it may be saide, that Good and Beautifull be after a sorte one selfe thing, especially in the bodies of men: of the beautie whereof the nighest cause . . . is the beautie of the soule" (310).

But it is woman who makes body and soul one, achieving the beauty of angels. For Castiglione the supreme lady was the Duchess of Urbino. She achieved perfection. Her presence made the palace "the very Mansion place of mirth and joy." The greatest pleasure in life was to please, the greatest grief to offend, her. Her spirit linked the courtiers together in a circle of love (20) and such love, beyond discourse of reason, merged the soul with God (319).

Fed by this ambrosia, the Courtier had it as his duty to live a pattern for other men, to be particularly the pattern of justice to a reigning prince. Should his prince fall into evil courses, then it would be the supreme test to win him back to virtue, to "clense and scoure that soule" (268), and even by use of disparaged custom bring it back to a firm basis whence by degrees it might lift again to the sovereign level of Reason (283).

Hamlet was such a Courtier: at the beginning a student, a "sweet prince," seeing men and nature from college windows, and believing of them what the noblest "saws of books" taught him (I v 100-). His mother was *his* "Duchess," and more than his duchess because she was his mother. Her hasty and unseemly marriage to a man whom he understood about as well as Gentillet understood Machiavelli almost wiped out for him the

(*Continued on Page 34*)

Ethel Hurlbatt, LL.D.

WARDEN OF THE ROYAL VICTORIA COLLEGE, 1907-1929

By SUSAN E. VAUGHAN

WHEN on the first of December last the news of the death of Sir Arthur Currie came to Miss Hurlbatt in the French pension where she was living in retirement, the serene philosophy which had sustained her through many trials came near to the breaking point. To her, who would gladly have given her remnant of life for McGill and its Principal, it seemed an inexplicable irony that she should live on in passivity while this powerful man, ten years her junior, was snatched away from his unfinished work. In an intimate letter, written on that sorrowful day, she recalls the fact that some five years earlier she and Sir Arthur were fellow-convalescents in the Royal Victoria Hospital. Miraculously recovered from an illness which had brought her to the brink of the grave, she knew at that time that her own professional life was over. Her lot henceforth was to be cast in quiet places, her pace that prescribed by her physicians. But for her companion, with whom she discussed College policy so eagerly and happily, surely there were still years of usefulness ahead. And now—what an irony!—"The one taken and the other left." She was not to be left very long. Three months and three weeks after the University and the Army had united to make the funeral of Sir Arthur Currie a landmark in the history of Montreal, a little group of friends, French and English, stood round a flower-decked coffin in a garden in Touraine, and paid their tribute of respect to the woman whom they had known for less than a year, but whom in that time they had learned to love and admire. "De cette femme de cœur," wrote one of them, "il ne nous reste qu'un doux souvenir; elle a passé au milieu de nous toujours bonne et dévouée, cherchant à faire plaisir à tous."

Such was the impression made by Miss Hurlbatt upon the associates who happened to be near her at the close of her life. Upon her Montreal friends, upon her co-workers at McGill, and especially in the Royal Victoria College where she lived for more than twenty years, the stamp of her personality is something far too complex and profound to be conveyed in a brief article. An attempt must be made, however, for, lacking some record of the life of Ethel Hurlbatt, LL.D., Warden of the Royal Victoria College, 1907-1929, the files of *The McGill News* would be deficient indeed.

The years before her arrival in Montreal, though they constitute the greater part of her life, and some important phases of her work, must be but slightly outlined. Knowledge of them comes to the writer at second hand and is open to correction.

Ethel Hurlbatt was born July 1st, 1866, at Bickley in Kent, where the Hurlbatt family had been known for several generations. Her father, Charles Hurlbatt, was a mining engineer with an office in London. He narrowly escaped being one of the pioneers of the South African diamond mines, an escape for which Miss Hurlbatt always professed herself devoutly thankful. It is futile to speculate upon what effect great wealth might have produced. As matters stood, the little girl, being one of a family of seven, knew quite early that she and her three sisters were expected to make the most of their educational opportunities, with a view to shaping careers for themselves later on.

We have few details about the preparatory stages. It has been stated in some published accounts that the remoteness of the family residence from good schools obliged Miss Hurlbatt to prepare for her matriculation examinations unaided. On the other hand, I have a vivid recollection of her tribute to at least one of her schools where an exceptionally fine course in history was offered to the pupils. Her own pleasure in this course influenced her afterwards to read for Honours in History at Oxford.

She went up to Somerville in 1888, the year in which the first women B.A.'s were capped at McGill. The higher education of women was a new thing in the world in those days, and on both sides of the Atlantic groups of eager girls were dedicating themselves to it with high seriousness and tingling enthusiasm. At Oxford they had in addition to new and stimulating courses of study, all the charm of "that sweet city with her dreaming spires." They had also the charm of an ordered and dignified life in their College, set in its garden. Its discipline, which to our untramelled younger generation sounds unduly

cramping, hardly touched their consciousness. Except in convents, young women above the age of schoolgirls had not before experienced the joys of community life, and this was something far wider than the conventual rule allowed. Released from domestic limitations, these young intellectuals shared interesting pursuits and developed friendships, naturally and agreeably. Contemporary with Miss Hurlbatt at Somerville were Hilda Diana Oakeley, destined to be her predecessor at McGill; Emily Penrose, future Warden of Somerville; Cornelia Sorabji, an exotic figure in her beautiful Indian draperies, to become later well known in three continents, and many others who became Miss Hurlbatt's life-long friends. Miss Sorabji, still beautiful and exotic, visited Montreal only a few years ago, and in familiar conversation with students and tutors at the Royal Victoria College brought before them pictures of their Warden as she had known her long ago. She recalled a tall, blue-eyed girl, rather clumsy in her movements, a little slow in making up her mind, but always vigorous, always to be depended upon, never taking offence, and sometimes delightfully merry. "We called her Hurly," said Miss Sorabji affectionately, "and sometimes Hurly-burly," she added, with a gleam of tender mischief in her dark eyes.

Something of Oxford these women took with them when they went out, as most of them did, to teach or to take executive posts in younger colleges. But they had been trained in too intelligent a school to be copyists. One of Miss Hurlbatt's strong convictions was that an institution which turns out students stereotyped in one pattern is a failure. She paid the tribute of profound respect to Somerville wardens of her time, Miss Lefevre and Miss Maitland, but she did not imitate them when in her turn she became warden of a college.

Fortunate in living at a time when opportunities were multiplying rapidly and competition had not yet become acute, Miss Hurlbatt and her friends proceeded to interesting positions at a much earlier age than their present day successors can expect to do. It should perhaps be added that they were in some directions more mature and better informed than the average present day graduate. Miss Hurlbatt's first opportunity came immediately after leaving Oxford, when in 1892 she was appointed Warden of Aberdare Hall, Cardiff, the newly founded Women's Residence of the University of Wales. There she remained for six years, doing pioneer work at first, seeing the new college firmly established, and, incidentally, forming a strong bond with Wales and its people which was to be a permanent one.

In 1898 came a larger opportunity, the Wardenship of Bedford College for Women, one of the many units of the University of London. For another eight years this was to be the scene of Miss Hurlbatt's life and labour. Before that period closed, the College had moved into its present splendid quarters in Regent's Park. The negotiations involved in this forward step and the many incidental changes meant a laborious succession of committee meetings, and a prolonged strain which told severely upon the Warden. Probably the years at Bedford College were among the most taxing in Miss Hurlbatt's life. They also added greatly to her reputation, so that when Lord Strathcona and Sir William Peterson were looking for a successor to Miss Oakeley, she was the most distinguished woman in the field.

The appointment was made in the summer of 1906, but it was January 1907 before she was free to come to Montreal. As it happened, she sailed on the same ship which was bringing Lord Strathcona on one of his many trips, and she has put on record some of her impressions of conversations during the voyage with the Founder of the College which was to be her home for the next twenty years.*

In the bitter winter weather of the earliest days of 1907, Miss Hurlbatt arrived in Montreal, She was then in her forty-first year, but those who saw her for the first time thought her older. Her blue eyes were keen and piercing, also at times, both friendly and merry, but the crown of hair above the high forehead was already grey, and the tall, commanding figure had lost its suppleness. The clear red and white of a typically English complexion, the vigorous hand-shake, and a habit of energetic action gave an impression of exuberant physical health and well being; but those most closely associated with the new Warden were soon to discover that this impression required modification. As a matter of fact, Miss Hurlbatt was all her life handicapped by certain constitutional weaknesses, especially in the nervous system, and her work was done at the expense of great fatigue and interrupted by recurrent attacks of illness. Her heavy duties in London had taken serious toll of her strength, and it was partly in the hope of relief with a less taxing programme in a smaller community that she accepted the Canadian position.

The first years seemed to bring the fulfilment of her hopes. Exhilarated by the frosts of her first Canadian winters, she renewed her strength and found abundant vigour and enthusiasm for the cultivation of her new field. Always keenly

*The McGill News—Dec. 1929.

interested in people, and in national as well as academic politics, she was alert, active and open-eyed. She loved to extend the hospitality of the College to interesting visitors, and the guest-book on her office table came to contain a long roll of honoured names.

But again her health began to cause uneasiness, and there were already disquieting symptoms when the war years came, bringing their intolerable stresses and strains. Miss Hurlbatt was not one of those whom the declaration of war plunged into hopeless misery. She was a well-balanced patriot, and she had the utmost faith in the then leaders of the British Government, Mr. Asquith and Sir Edward Grey. She therefore faced the prospect with composure, merely asking what she, as an individual and as one in authority over youth, ought to do. She remained at her post, adding to her usual duties those which extraordinary conditions put in her way. It was characteristic of her that she gave her efforts as freely to the interests of the Allied countries as to her own, and after the war she numbered among her proudest possessions her French and Serbian decorations.

But the years brought blow after blow. In common with her generation she suffered cruel losses—a favourite brother, a host of friends, English and Canadian. Through months of 1918 she lay ill, and was still in a weakened state when other calamities assailed her and the University. She struggled through the influenza epidemic of 1918, and witnessed the tragic breakdown of Sir William Peterson.

When the University began a new chapter of history under the leadership of Sir Arthur Currie, she was apparently restored to health, and rejoiced greatly in the inauguration of the new Principal, with whom she soon formed ties as strong as those which had held her to Sir William Peterson. She many times expressed her thankfulness for the privilege of having worked with these two distinguished men. Sir Arthur, on his side, lost no opportunity of testifying to his admiration for Miss Hurlbatt. On one occasion he confessed, naively, in a public gathering, that he had begun by being a little afraid of her. But that attitude soon gave way before her cheerful friendliness, and they became the happiest of colleagues. To Sir Arthur, as to many people, Miss Hurlbatt seemed in the early days of their acquaintance, to be a very strong person. He was greatly distressed to find that this was not the case. Signs of declining health showed themselves throughout the first years of his principalship, and at the opening of the session of 1924-25 it was found advisable to grant Miss Hurlbatt leave of absence for a year for complete rest and recuperation.

Unfortunately the winter in Italy was only partially successful as a means of restoration, and Miss Hurlbatt came back with health still impaired. She returned to her post for the sessions of 1925-26, 1926-27 and the first part of 1927-28, but in March, 1928, she was stricken by serious illness and was removed to the Royal Victoria Hospital. Her formal resignation was not accepted until 1929, but her role as Warden ceased to be an active one from the time that she was admitted to the hospital. There she was to remain for over a year.

After so sad a chronicle, it is a relief to be able to record that Miss Hurlbatt in the last five years of her life had an interval of comparative freedom from care, in which she was able to travel, to visit friends on both sides of the Atlantic, and to occupy herself with various congenial pursuits, notably with sketching, which had always been the pastime of her leisure moments. There were also occasions of more exalted pleasure when honours and tributes were offered her with the most gratifying accompaniment of respect and affection. While she was still a patient in the hospital she was waited upon by two outstanding members of the Alumnae Society who brought her a purse containing two thousand dollars which they had collected in the hope that she would use it in travel for the completion of her cure.

At the Convocation of May, 1930, after a restorative winter in Bermuda, she had a veritable triumph when she came forward to receive the LL.D. degree. It was on that occasion that she made her last public speech as a member of the University, in which she referred to "the pleasure of being admitted to this good companionship of men and women—the greater honour that it falls on me as representing one of the most useful benefactions ever made to McGill, the Royal Victoria College." She included in her speech an eloquent plea for the continuance of such benefactions.

A few months later she sailed for England, but returned happily to Canada the following summer. She had come to feel that this was the natural place in which to spend her summers, but she was able to make the westward voyage only once again. Meanwhile she revisited with vivid interest Oxford, Edinburgh, Paris, Geneva, and other places to which she was drawn by some special attraction. Always her interests were in human affairs, in movements, policies, educational trends and changes. Never was anyone less of a recluse.

On the 4th of November, 1932, she sailed once more from Montreal. Two days earlier she had been the central figure at a large afternoon party at the Royal Victoria College where she was at her best. Friends of all ages, including a group of merry children, had gathered to bid her good-bye, with no foreboding that it was for the last time.

Her plan of coming out again when summer came round, was altered at the last moment, and she went to France, established herself in Tours, and enrolled as a pupil in the Institute de Touraine. Happily occupied with sketching and studying French, she extended her stay into the winter. Early in the New Year she was again overtaken by illness, and for two months or more was confined to her bed. Writing to her family and friends, she described her disorder as influenza, and it was not until all was over that they heard of the complication of severe heart attacks. Skilled treatment apparently got the better of the trouble, and she resumed her normal way of living. It was noticeable, however, that in her letters to Canada she was rather vague about plans, though she had taken a passage, provisionally, for an April sailing.

The brief cables announcing that Miss Hurlbatt had died on the 22nd of March carried almost unrelieved shock to hosts of friends in England and Canada. It seemed preposterous that, possessing these hosts of friends, she should die alone in a foreign land. Following letters brought much assuagement. It was realized that her heart condition must have made another journey an undertaking attended by dread and difficulty. Meanwhile she had enjoyed an interval of comparative freedom from pain, in the daily companionship of an English friend, lately acquired, but strongly attached as her friends were wont to be. On the morning of the 22nd of March she wrote to a friend in Montreal, a normal note, devoted largely to comments on a book lately read. She had lunch in the public *salle à manger* and went upstairs to rest. The final attack must have been a brief one, for, when found later in the afternoon, she was lying in a natural attitude, her face calm and even smiling. The most tender-hearted of her disciples could not have devised for her a more peaceful exit from the troubles of this unintelligible world.

The question has been asked several times why no memorial service was held at the University for one of its members so conspicuously worthy of it. The answer is very simple. Miss Hurlbatt, staunch Christian though she was, left it on record that she desired neither of those conventions of Christian practice, a memorial service or a memorial stone. In accordance with what it is felt would be her unspoken wish, the Alumnae Society at once organized to establish in the Ethel Hurlbatt Scholarship a memorial more appropriate than one of brass or marble to the leader whose name they revere.

I have achieved the outline of a life-history. Have I done anything towards conveying the impression of a personality? I doubt it. And I doubt whether an additional paragraph or two will do much towards supplying the deficiency. The whole region of the relation of Miss Hurlbatt to her students remains almost unexplored and must so remain. Following the principle that the postcript often conveys more than the letter, I attach to this imperfect chronicle a tribute brought to me by one of those students who for many years were Miss Hurlbatt's chief concern. From it I borrow the clause: "She commanded attention and respect."

It is a very significant phrase. Miss Hurlbatt in her relations with students and those who had passed beyond her tutelage might intimidate, she might occasionally repel, she could not be disregarded. Partly this was the effect of her physical endowments. The unusual height and weight, the large powerful head, gave an impression of physical force, which, as I have shown, was not justified by actuality. Yet the effect existed, as this sincere tribute, which might be many times multiplied, shows. But much more than the physical presence, imposing though that was, Miss Hurlbatt's intellectual and moral forcefulness, her unwavering justice, and the strenuousness of her ideals commanded attention and respect.

On her side, Miss Hurlbatt saw all students, whatever their individual capacities, as persons set apart from the common herd. Once they had learned the magic password of matriculation, they were members of the University, students of the College, and until such time as they were proven flagrantly guilty of unworthiness, she trusted them, and in turn they gave her their trust and respect. Those who remained longest and knew her best gave her also sincere affection.

The fact that by becoming members of an institution students acquired a new importance in Miss Hurlbatt's eyes, gives us a key which unlocks many mansions in her house of life. She was not in any sense a rebel or a stickler for individual rights. On the contrary, organized institutions, representing as they did the accumulated sanction of the ages, had in her eyes rights which commanded and deserved allegiance. She gave hers unquestioningly to the Christian Church, the British

Constitution, and to many less venerable traditions. This is not to say that she advocated mere acquiescence in the scheme of things as they are. She was keenly alive to all movements of advance and reform, but she was repelled by anything that looked like mere destructiveness and negativity. The principle of anarchism was inconceivable to her.

Such a temperament has the defects of its qualities—like all temperaments. Miss Hurlbatt's mind worked slowly and cautiously. It insisted upon making sure of each fact and principle in turn, and it refused to be stampeded. I recall the protests of fellow-workers, impatient committee members, perhaps, who felt that progress was being needlessly blocked. If any of them should read this paper I beg them to remember that in addition to an incorrigible conscientiousness Miss Hurlbatt's pace was retarded by the physical difficulties of which I have already spoken. If other members left the committee in a state of exasperated weariness, she was probably near to exhaustion and tortured by headache. When her solid reasonableness was opposed, as it sometimes was, by the brilliant sallies of irresponsible imagination, nothing but mutual misunderstanding could result. "I have just heard Miss Hurlbatt having a discussion with—," said an impish student on one occasion, "and now I know why the Irish question goes on and on." Even those very near to her and very sympathetic sometimes felt the sense of antagonism between any expression of pronounced individualism and her loyal constitutionalism. "I wish I had the sense of support which you seem to have in political parties and religious organizations," said a friend one day, somewhat wearied by a long and earnest talk. "I am too sceptical to get any thrill from them." "One doesn't *boast* of it, does one?" retorted Miss Hurlbatt, with something as near to exasperation in her tone as her unwavering reasonableness allowed.

Bertrand Russell says somewhere that he was taught English Constitutional History almost before he could read, and that he could hardly remember a time when the duty of public service was not before his eyes. The characteristically British attitude implied in this statement is one with which Miss Hurlbatt was perfectly familiar. She was a Briton and it was her duty to accept such public service as she could carry out. Conversely, she was slightly deficient in ability in those private services which come so easily to the average woman. Practical in mind, she was not practised in domestic arts. She had little skill of hand, and her surroundings were apt to be comfortless. It was not that her ideals were specially ascetic, but simply that she did not know how to do the cushioning and draping which most women do by instinct. "Miss Hurlbatt would not make a good Robinson Crusoe," said a penetrating student once. "She would not know how to make herself comfortable, and she couldn't tell lies about it afterwards." The practical deficiencies were not very conspicuous, because wherever Miss Hurlbatt went she was sure of having a friend ready and anxious to perform small services for her. Perhaps one can pay her no greater tribute than this, that throughout her life she drew friends to her, and that these friends invariably felt that whatever they did for her they were still her debtors since she led them into a world larger than their own.

In Memoriam

ETHEL HURLBATT

1866-1934

The Gods were very generous to her from the beginning.

She justified their bounty by assiduously cultivating her talents and by using her endowments of physical strength and forcefulness of personality in the unselfish service of Education and in the high exercise of friendship.

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In appearance and poise she carried dignity and authority above the average.

By intellectual strength and grasp of many things, she commanded attention and respect.

By untiring labour, perseverance and understanding, she achieved success in her chosen sphere.

By breadth of human sympathy, kindliness and wisdom, she exercised a beneficent influence on those around her.

By dauntless adherence to high ideals, by nobility of mind and heart and spirit, she set an high example which stands as a challenge and as an inspiration to many.

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The portals of the unseen world have opened and a noble spirit has passed through.

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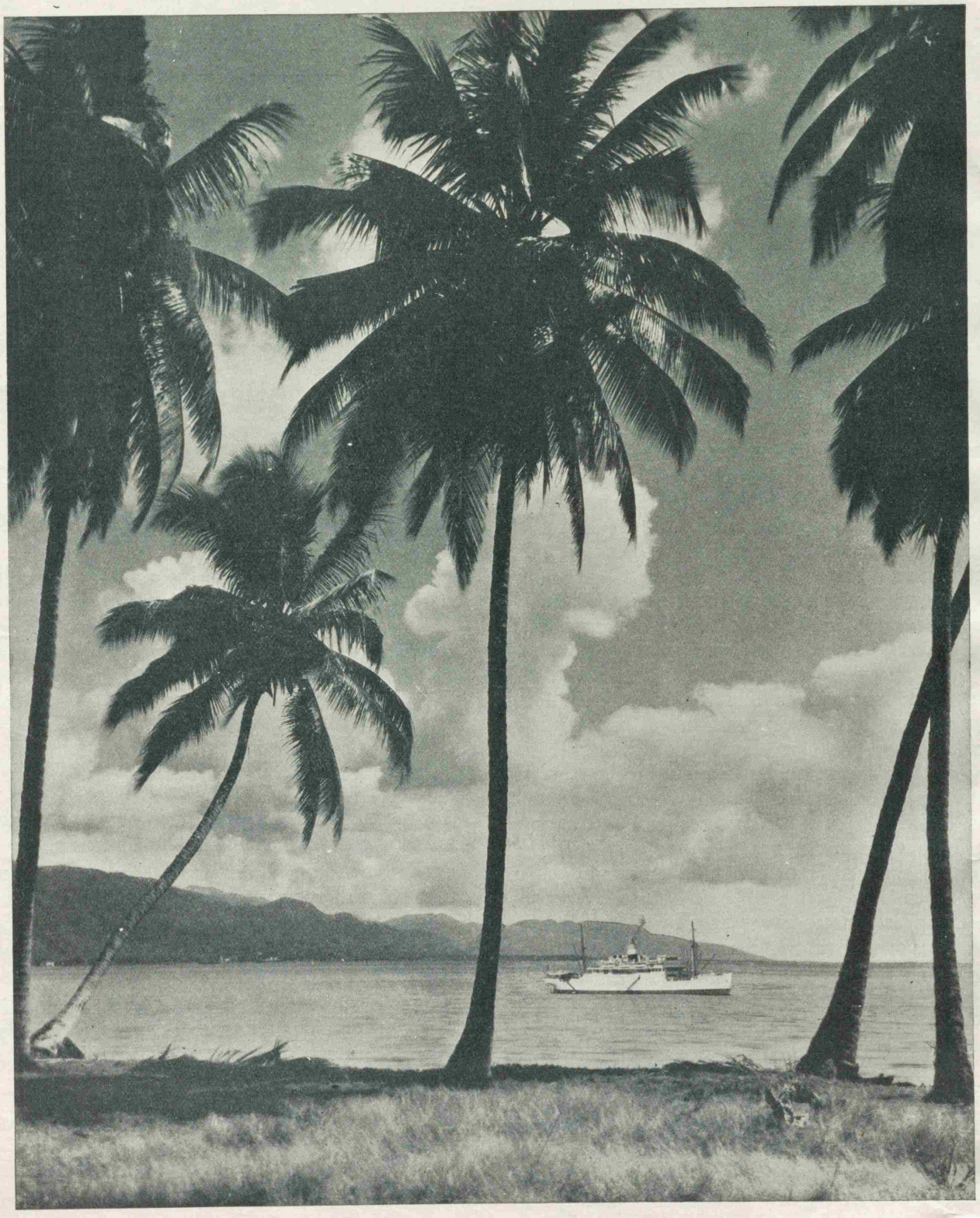
(To Miss Hurlbatt, a friend during 22 years, with respect, admiration and affection.—A.V.D.)



(Canadian National Steamships Photo)

IN MEMORIAM: Sir Robert Falconer

By
A. VIBERT DOUGLAS

Reprinted from The McGill News, Spring, 1944

IT WAS in the Fellows' Garden of Magdalene College, Cambridge, that I first met Sir Robert Falconer. The British Universities Conference was meeting in Cambridge that summer of 1921, and distinguished university men from all parts of the Empire were gathered there. I was working all through that long vacation in the Cavendish Laboratory and, knowing several of the Canadian delegates,—Dr. F. D. Adams, Dr. H. M. Tory, Professor William Caldwell, Sir Arthur Currie,—found myself included in some of the Conference functions. At the garden party given by the Master of Magdalene, a college founded in 1542, I was introduced to Sir Robert Falconer, whose kindly courtesy, beautiful voice and diction, and cordial friendliness impressed me immediately. He and his son were the guests of the Master of Trinity, Sir Joseph Thomson. He spoke of the rich experience of living in that historic college, the Master's Lodge of which is a Royal Residence on occasions, and so many rooms of which are even more famous because of the undergraduates who once inhabited them—Isaac Newton, Macaulay, Thackeray, Tennyson, Whewell. He spoke of his host—J. J. to all who knew him—one of the great men of Cambridge, kindly, whimsical, and full of anecdote and reminiscence. He spoke of the beauty of "the Backs," where the little river Cam runs through the College grounds; but it appeared that he had never been on the Cam, had never seen the Colleges from a punt or canoe on this lovely stream that wanders past eight ancient colleges and under nine bridges in a three-quarter mile stretch.

It so happened that I had hired a canoe for the entire summer and was in the habit of spending an hour or more almost every evening paddling up and down the Cam, so I knew and loved every yard of the way from Chesterton Road locks to the Mill Pool. Sir Robert welcomed the idea of coming to tea on the following Sunday and then paddling up through "the Backs;" and so it was that three of Canada's great educators—Sir Robert, Dr. Tory and Dr. Adams—forgathered on a hot summer day in student "digs" on the Chesterton Road opposite Jesus Green.

Of these three outstanding Canadian-born educators, two are gone from us. Different in many ways as these men were, they have had much in common. Throughout the last half century, each has poured out his energies unstintingly upon Canadian youth and upon Canadian institutions of learning and research. Each has had unswerving faith in Canada; each had a vision of its future and of the essential part that education must play in developing a strong, healthy awareness of national and of international relationships and responsibilities. One has been a pioneer all his years, carrying higher education to British Columbia, to Alberta, and in 1918 to the Canadian Army overseas. He was the driving force in establishing the National Research Laboratories; and now in these latter years, he has been the chief motive power in establishing and launching the latest educational venture, Carleton College. The other two have added lustre to Canadian scholarship, one in the humanities and religion, one in science and the history of science; and they accomplished this while carrying heavy administrative tasks, one as President of the University of Toronto, the other as Professor, Dean, Acting-Principal and Vice-Principal of McGill University. All three have been men of high Christian character, of great intellectual integrity, of strong simple faith in spiritual values and spiritual revelation,—to all three might be applied some words written recently by Principal Malcolm W. Wallace and Dr. W. R. Taylor in their tributes to Sir Robert: "There are those who never cease to grow," whose religion "acquired by assent must be re-won by an effort of the mind and will," whose passion it is "to understand more clearly the enigma of life," "who by sheer power of personal worth keep strong our faith in moral and spiritual values."

After tea on that hot, quiet Sunday afternoon, we walked over to Crowe's Boat-house. Sir Robert was interested to hear about old Crowe and his son. The latter was unable to enlist in 1914 because of severe deafness, but the father, though over age, got himself accepted and served in the Army until a fall led to a broken limb and his discharge. He had then returned to his boat-house, his punts and canoes. Great was his satisfaction in his own army record and his pride in the position of trust held by his son, who had become technician in the Cavendish under Sir Ernest Rutherford, preparing for him and for all of us who worked in his laboratory the sources of radio-active discharge which were needed in our work.

Sir Robert took his place in the centre of the canoe, his son took the stern paddle, I the bow paddle, and we set off upstream, past the ivy-clad walls of Magdalene, with its memories of Pepys who contributed towards a new library and bequeathed to the College all his own books and his red oak bookcases. Passing

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under Magdalene Street bridge, we came to the narrow part of the river flowing between the walls of the old and new buildings of St. John's College. These buildings are connected by the covered arched bridge known as the Bridge of Sighs. Beyond this the view of the next two bends of the river opens up with ivied walls, college buildings, towers and turrets on the left, and grey stone bridges giving access to the green lawns, lovely trees, weeping willows and flower gardens on the right. We talked of some of the sons of this college—William Wordsworth, Matthew Prior, Samuel Butler, Sir John Herschel, William Wilberforce, Henry Martyn—as we paddled under St. John's Bridge and on between the green lawns of Trinity College where the arcades and Grecian stateliness of Sir Christopher Wren's Library held our gaze. Then skirting the walls of Trinity Hall which had nurtured Lord Howard of Effingham, and Clare College with its greystone bridge, we approached the lawns and gardens of King's College, whose stately chapel rises to the glory of God and as a monument to two Kings of England,—Henry VI, who founded the College and planned the erection of the Chapel and Henry VII, who provided the funds for its completion. We passed under King's Bridge, watched undergraduates sitting on the river bank as they fed the ducks that frequent that stretch of the river, viewed the buildings of St. Catherine's College and then paddled along by the red brick walls of Queens', and under its wooden "mathematical bridge" whose every timber is set tangential to the curve which it and all its fellows envelop. Here one inevitably thinks of Erasmus, who held the chair of Greek at this College about 1510, and so as we paddled on into the mill pool, the talk was of reformation by restatement as opposed to reformation by revolution.

Beyond Silver Street bridge, a sharp turn to starboard brought us into a dark, narrow bit of the river between a wooded island and the walled garden of Lady Darwin, widow of Sir George of Trinity College, the son of Charles Darwin of Christ's. Over the stone retaining wall, hung the silvery olive green leaves of sweet lavender and, from the canoe, one could always pluck a fragrant blossom or two in passing.

The fragrance of sweet lavender—this perhaps is as good a metaphor as any, when recalling memories of that Sabbath afternoon, twenty-two years ago. The years that followed brought further happy contacts on a few occasions,—tea in Sir Robert's own garden when the British Association held its 1924 meeting in Toronto, and some friendly gatherings at times of conferences. I think, too, of a masterly address at the McGill Union on the League of Nations, of a scholarly and inspiring address at a meeting of the Bible Society in Montreal, and of the charm, grace and sincerity of his vote of thanks to Dr. G. S. Brett after the latter had delivered his presidential address some years ago to Section II of the Royal Society of Canada. I have long thought that, as a speaker, Sir Robert had no peer in this country. The music of his voice, the polish and balance of his sentences (so well described as "distinguished English"), the quality of his thought, and the conviction that lay behind all he said—this combination is all too rare.

It was a book by the late Master of Magdalene, Dr. A. C. Benson, which brought to my attention the words of a chapter-heading in the Book of Proverbs, "a sincere and kind familiarity with wisdom." This phrase seems right and fitting, and comes unsought into my mind as I venture to pay this tribute to the memory of Sir Robert Falconer.

PRINTED IN CANADA

In Memoriam

HEBER JAMES HAMILTON

by A. Vibert Douglas of Queen's University

and G. Vibert Douglas of Dalhousie University

There are those whose lives form such a complete whole that to mourn their passing is comparable to mourning the last vibration of the closing bar of a great symphony. The life of Heber James Hamilton, first Bishop in Mid-Japan, was a symphony, rich in many varied interwoven strands of melody, full of gentle kindness and sparkling humour, strong with an unhurried dynamic quality, inspired throughout by thoughtful, unsentimental love of God and consecration to the service of needy humanity.

Born in Collingwood on December 16, 1862, third son of William Basil Hamilton and Jessie Jameson Campbell, he grew up fond of outdoor life, observant of trees, flowers, birds, and skilful in carpentry and mechanical things. He read widely at the Collingwood Grammar School and Collegiate Institute and developed his amazing memory for accurate facts over an ever-widening range of interests. Entering the University of Toronto in 1881, he made history his major subject, but he did not confine his studies to one field. He took courses in mineralogy with Professor Chapman and many years afterwards he was still keenly interested in minerals. In fact he had the ability to project himself into almost any subject in a remarkable way. With this breadth of interest was coupled a determined, critical sense. When he had thought out a problem and arrived at a decision, he stood fast on his ground. By working in the vacations with his brother, L. A. Hamilton, on land surveys connected with the building of the C.P.R. and the laying out of Moose Jaw, Medicine Hat and other western towns, he gained experience of men and of technical and economic affairs. Upon his graduation in 1885 with the B.A. degree, he became articled to Mr. John Hoskin, of the legal firm of McCarthy, Osler, Hoskin and Creelman in Toronto.

A growing conviction that his real life work should be in the ministry of the Anglican Church led him to give up the law within a year and enter Wycliffe College in November, 1885. Here he read deeply in theology, history and Greek, and was ordained Deacon in 1887 and Priest in 1889. He was Curate of St. John's, Port Hope, during these two years. However, his intellectual and personal qualities were such that he was called back to Wycliffe as Professor of Church History and Dean of Residence in 1889. Fifty years later if one asked him a question about Clement of Alexandria or Augustine or some Council of the early A.D. centuries, his face would light up with pleasure as he recalled this and that from his stored memory and as he turned to his book shelves to place his hand without hesitation upon the source of further information. With his love of knowledge, his humorous kindliness, his contagious enthusiasm, he would have become a great teacher. But his nature demanded an outlet less happily sheltered than the university environment. The call and challenge of missionary service fired his spirit and he went to Japan in November, 1892, as a member of the Wycliffe Missions. A year of intense study gave him the beginnings of what became a quite remarkable mastery of the language, and for the next forty-two years he ministered to the spiritual and physical needs of the Japanese people.

In 1894, Heber Hamilton married Minnie Spence of Toronto, and from their home in Japan, whether in Gifu, in Tokyo or for many years in Nagoya, a powerful influence spread and diffused into many phases of Japanese life.

In 1905 he became Secretary of the C.M.S. Central Japan Mission. From this time his great executive ability found certain scope and his judgment in financial matters of expenditure and investment let to expansion of the work and the best use of what he always regarded as trust funds. His educational ideals and vision are exemplified by his reorganization of the course of instruction for blind Japanese, for whom massage was a reserved occupation. He advocated proper courses in anatomy and physiology and thus raised the professional standards and status of this occupation to a high level. He was also responsible for the first Kindergarten teacher training school in Japan.

When a readjustment of missionary fields was made in 1912 and the Canadian Diocese in Mid-Japan was created, Heber Hamilton was chosen as its first Bishop. He was consecrated on October 18, 1912, at Christ Church Cathedral in Montreal.

The next twenty years were filled with manifold activities. Not only was he spiritual leader in his own large diocese, he was consulted by Christian workers of all denominations, by government officials who recognized the value of his advice and experience, by officials of the foreign embassies, by educational and welfare leaders; he was respected by all these and by Buddhist priest and humble labourer. He conceived the idea of building a model sanatorium in the mountains of Japan to introduce modern methods of treatment of tuberculosis to a people badly ravaged by that disease, whose sufferers were crowded into unsanitary hospitals at sea level without hope of recovery. He spent most of a furlough in 1927 travelling across Canada preaching and pleading for support of this project. With the help of co-workers in this great venture of faith, the funds were raised. In due time this medical centre was erected and a Canadian doctor and matron directed a native staff. Its operation and the good results which followed did not pass unnoticed by the Japanese authorities. Though it had to be abandoned by the Mission and all its x-ray equipment was removed by government order during the recent great war, it has been re-equipped since 1946 and is once more serving its humane purpose.

Bishop Hamilton retired in 1934 at the age of seventy-two. The hope underlying all his missionary endeavours was that Christianity might take root in Japan so that its influence might permeate the nation from within. It was therefore with deep satisfaction that he saw Bishop Sasaki, a Japanese, consecrated as second Bishop of Mid-Japan. Bishop Powles, writing recently from Japan, testifies how well the foundations were laid: "The Japanese church in Mid-Japan realizes more fully as time passes, the debt of gratitude they owe Bishop Hamilton. They know that it was owing to his leadership and policy that this diocese held together during the war."

On retirement, Bishop and Mrs. Hamilton made their home in Toronto, and to it those who loved them came, enjoyed the gracious warmth of their hospitality and the talk of people or books or world affairs, listened to some of his inexhaustible fund of stories told with a merry twinkle in his eyes, and went away richer and happier in mind and spirit. One who knew him well has written, "Heber Hamilton will be remembered for many qualities, not the least of which was his special type of humour. He did not keep this sense of witty amusement in a separate compartment. It invaded almost every occasion and seemed an inseparable part of himself. Those who revel in the lugubrious interpretation of life and religion found him no companion in their gloom. This characteristic buoyancy of spirit, coupled with his objective Christianity, seemed to create in him a rare serenity. Anything pompous, self-important or professionally religious could not be found in his nature." (O.M.C.D.)

As long as health permitted, Bishop Hamilton preached on many occasions in various places and conducted a service monthly in Japanese for the Japanese citizens of Toronto. He visited shut-in friends and the Old Men's Home weekly, radiating the sunshine of his deep simple goodness

everywhere he went. Mrs. Hamilton died on March 30, 1951, and Bishop Hamilton on January 4, 1952.

It is well for us to contemplate the life of a man like Heber Hamilton. His was a very full and well-rounded personality. He never sought the limelight and yet he has left a record of grand achievement. In his lifework he was a wise planner and a determined doer. It is not generally known that he was also a fine mountaineer. With the Rev. Walter Weston, as early as 1894, he conquered many of the rugged mountains of the high ranges of Japan, taking some of the earliest photographs of those snow capped alpine peaks. The emergence of Canada into nationhood is the result of the labours of men in many walks of life. Not least, indeed perhaps very largely, it is due to men like Heber J. Hamilton, who were born and educated in Canada and who have carried the name of Canada far beyond her frontiers, setting high standards of ideals and achievement wherever they have gone. For such men we can say with Augustine, *Gratias tibi Domine.*

Dust

by Robert Finch

I met a man with a cane of care,
He made me stop and said his say:
A theologian of despair,
I come to take your joy away.

But that, I said, you cannot do,
It is always mine because always given.
No man takes the joy from you
Sprung from our Advocate in heaven.

His joy is broader than debate
And higher than the eagle's air,
His joy is not an opposite
For it is deeper than despair.

And in the tribulation here
Till earth dissolve and sky be furled
That joy brings cheer to be of cheer
Through him who overcame the world.

He looked at me with eyes athirst
And shook his walking-stick of pain:
No, men must be creative first,
He cried, and hurried off again.

And on the wind, as so it must,
Dust blew back from his fading feet
To this dust which like his anxious dust
One day will blow along with it.

EIGHTH GENERAL ASSEMBLY OF THE INTERNATIONAL ASTRONOMICAL UNION

By A. Vibert Douglas

Astronomers from thirty-four countries and the Vatican City State met together in Rome for the I.A.U. General Assembly from September 4–13, 1952, under the presidency of Professor Bertil Lindblad, Director of the Stockholm Observatory.

More than 430 names were listed as participants. The Italian committee under the convenership of Professor Giorgio Abetti had made admirable arrangements for the congress. The National Research Council provided its fine building near the entrance to the Cita Universitaria as headquarters, and its distinguished president, Professor G. Colonnetti, welcomed the delegates at the Inaugural Ceremony in the historic municipal palace at the Campidoglio on the Capitoline hill. At the Campidoglio also, the evening reception was held with its opportunities for informal meeting of old and new friends from many countries, in the setting of frescoed rooms, corridors hung with art treasures, the extensive stone terrace where a string orchestra played, and below in the lovely walled garden with its flowers and fountains, trees and statuary. For those of us who met her, the interest of that gathering was widened beyond the limits of astronomy by the presence of a citizen of Rome who has watched the history of her country for three score years and ten and played her part in her country's life with vigour and with devotion to the great family tradition, Miss Rosa Garibaldi, granddaughter of the man whose name is still one to conjure with in Italy.

The general meetings were held in the Aula Magna of University City, the Commissions and Symposia in the excellent classrooms of the Institutes of Physics and of Mathematics. Draft reports of thirty-three commissions were available. In addition to the meetings of the commissions, either singly or in joint sessions on interrelated subjects, a special feature

R.A.S.C. Jour. Vol. 46, No. 6

was the introduction at this assembly of symposia on solar and terrestrial relationships, stellar evolution, astronomical instruments, spectra of variable stars, and on the astrometry of faint stars.

The symposium on stellar evolution was opened by Professor V. Ambartsumian of the U.S.S.R. He discussed two kinds of stellar "associations", O and T, the former comprising mostly the high luminosity O to G stars, the latter the G to M stars in the lower part of the main sequence. Stars are being born into both these kinds of associations at the present time. A discontinuity exists in the early G stars as to luminosity and velocity indicating a distinct separation of the O and T associations. Parenago and Masevitch believe the internal structures of these two groups of stars are different and are due to two mechanisms which are operating in the galaxy. Stars are formed in the filaments and the "caillots" of diffuse nebulae. Evolution of stars due to accretion is ruled out by the facts as interpreted by Russian astronomers.

Papers followed by Fessenkov and Shajn. The former claims that surrounding certain stars are small dark halos and he interprets these as relative rarefactions in the cosmic dust around the star due to repulsion. Gurzadian has investigated the interaction between stars and interstellar hydrogen, with results contradicting conclusions of Hoyle, Lyttleton, Bondi and Weizsäcker, who regard accretion as a major factor. Fessenkov stressed the important part played by corpuscular radiation in stellar evolution. Shajn's paper dealt with the intricate structure of filaments in diffuse gaseous nebulae, revealed in his photographs taken in the light of $H\alpha$. Fine reproductions of a dozen of these beautiful plates accompanied his paper which, with those of Ambartsumian and Fessenkov, were given to every delegate in the three languages—Russian, Italian and French. Shajn emphasized the intrinsic importance of electromagnetic forces, not merely or even primarily gravitational force, in explaining the structure and behaviour of ionized nebulosity and the conditions requisite for the formation of great groups of hot stars, "associations", or of isolated stars.

This symposium continued with papers by Lindblad and Oort. The latter discussed expanding motions in groups of early-type stars, the perturbing force of the galaxy becoming effective after 10 million years in elongating the group, the ages of groups being proportional to the axial ratio. Baade contributed a paper on young and old stars; the former are high luminosity O and B stars and associated stars of lesser mass which form population I, all originating in the large gas and dust regions composing the spiral arms of galaxies; the latter are found in

globular clusters and their evolutionary track up or away from the main sequence depends upon their hydrogen content and the degree of mixing. If the hydrogen-exhausted core contains about 10 cent. of the star's mass rapid departure to the right of the main sequence takes place and population II stars are therefore old stars with ages of the order of 3×10^9 years and greater. The young stars are 10^7 years and less.

Hoyle followed with a discussion of the role of accretion in the birth of a star and in binary star evolution. His ideas were strongly criticised by the U.S.S.R. delegates. Greenstein and Schwarzschild discussed the chemical composition of stars of population II (deficient in heavy elements, perhaps formed from early gaseous clouds before much dust had developed) and of population I (rich in heavy elements and of recent birth in the dust and gas cloud regions). Schatzman who had largely organized this valuable symposium brought it to a conclusion with a paper on white dwarfs. Among those contributing to the general discussion were Alfven, Kuiper, Masevich, Lyttleton, Bondi and Gold.

Commission 12 on solar radiation under the chairmanship of Dr. Minnaert provided interesting reports by Nicolet on the distribution of energy and of the urgent need for an absolute measurement at some wave-length; by Dodson on the McMath 70-foot solar tower infra-red atlas, and the evidence for nitrous oxide and carbon monoxide and several isotopes in molecular bands; by Brück of Dunsink and by Severny of Pulkova on tracing line profiles. As in 1948 at the Zurich congress, emphasis was laid on the need for more accurate measurements of both the solar constant and the solar magnetic field.

Commission 10 on photospheric phenomena under Dr. Waldmeier ran into a debate on the method of recording sun-spot areas—Allen wants projected areas, Newton wants both projected and corrected areas, the U.S. Naval Observatory by the photographic method in use can give only the latter. Another debate centred around the merits of referring polarization phenomena to the plane of vibration or the plane of polarization. This was in Commission 34 on interstellar matter. Hall, Zanstra, Swings, Menzel and Drefus had strong opinions on this and on nomenclature for regions of H and H ions. The valuable report by Otto Struve included summaries of the work of about 22 Russian astronomers on interstellar dust, general and selective absorption, sizes of particles up to 100 millimetres in lower galactic latitudes, effects of absorption on star counts and colours and the dimensions of clusters, and metagalactic absorption estimated at $0^m.025$ per megaparsec. Gold discussed the electromagnetic fields in interstellar space as proven by the polarization of starlight and

sketched the outline of his forthcoming theory based upon the relative velocities of dust-particles and gas and their orientation to the galactic plane.

To Commission 40, set up in 1950 to embrace radio-electric observations, Ryle described the location by radio interference of two intense sources, Cas 23 N58 and Cyg 19 N41, the former about 5′.5 in diameter, the latter 3′.6. Baade reported that the 200-inch was used on these areas with interesting results. The Cassiopeia region contains a nova-like nebulosity with filaments, spectra of which show Doppler shifts up to 1500 km. per sec. One filament shows H lines, another does not. These present a new phenomenon. The Cygnus region shows two external galaxies interpenetrating with high excitation spectra, nebular emission lines, and a red shift of 16,500 km. per sec. One other region is known where two galaxies are colliding and an emission spectrum produced. Baade urged that this region be investigated for radio noise. The inference was drawn by Hoyle and Gold that the source of radio noise appears to be a region of gas in violent motion, such turbulence being found in various places in our galaxy and in M 31 and other galaxies, in supernova shells, and where two galaxies are in collision.

Reporting on radio noise from the sun, Ryle stated that at wave-lengths 60 centimetres to 7.9 metres the radio intensity at the equator extends to 30 radii. Dodson reported on 194 flares in 1948–50 of which 151 were accompanied by radio bursts on 200 megacycles. Sometimes the radio preceded the optical phenomenon, sometimes followed it, and sometimes they were concurrent.

Commission 28 on extra-galactic nebulae received an intensely interesting report from Baade on a re-determination of the distance scale by means of classical Cepheids which involves a factor of about two. Thus M 31, being twice as far away as previously believed, is therefore of a size comparable to or greater than our galaxy. (One recalled the voice of Eddington twenty-five years ago protesting against the premature declaration of some astronomers that our galaxy was a continent and all the others mere islands!). Questioned by Shapley, Baade gave the details of the investigation on 4-day Cepheids in the nucleus of M 31 leading to a correction of $-0^{m}.8$ in the Cepheid period-luminosity relation. Oort reported that connecting some galaxies there appeared to be luminous matter with some spectroscopic evidence that it is gaseous and partly oxygen.

The Joint Commission on spectroscopy under chairmanship of Dr. Meggers discussed at length the new tables of wave-lengths and the need of extensions of these, with Unsöld and others pleading the relative

importance of various weak spots in our present knowledge and urging concentration on what each felt to be most urgent. Herzberg's provisional report on spectra of polyatomic molecules was received with much appreciation.

At the final general assembly of the Rome Congress two important announcements were made: the election of Professor Otto Struve of the University of California as President of the Union for the forthcoming three years, and the decision (effected by polling each country) to accept the invitation of Eire to hold the next congress there in 1955.

Many meetings of course were going on simultaneously so that delegates attending some commissions completely missed others. The above brief outlines indicate only a part of what went on during a busy week. Three expeditions had been arranged, one to Castel Gandolfo where the Vatican Observatory is now admirably housed and where His Holiness Pope Pius XII welcomed the congress and read a speech in French, afterwards blessing the faithful individually and shaking hands with the others most cordially. Everyone was impressed with the astronomical equipment, the astrophysical laboratory, and the situation on one ridge of the volcanic Monti Albani by the deep blue crater lake a thousand feet above sea level. The second trip was to Monte Mario on the western outskirts of Rome where solar work is carried out. Lastly was the excursion to Ostia where extensive early Roman excavations were visited and the closing dinner was held by the shore of the Mediterranean at Ostia Lido with the National Research Council as hosts.

To the Royal Astronomical Society of Canada which named me a member of the Canadian National Committee of the I.A.U. my warmest thanks are extended, and likewise to the other members of this Committee for electing me a delegate to the VIII General Assembly of the I.A.U. These meetings have re-established invaluable personal contacts and made possible increased co-operation in astronomy and allied sciences.

Queen's University, Kingston.

INTERIM REPORT ON COMMISSION 41, I.A.U.

By A. Vibert Douglas
Kingston Centre

Since the General Assembly of the I.A.U. in Hamburg in August 1964, further issues of the *Bibliography* of books and papers on the history of astronomy have been prepared by Mrs. N. B. Lavrova (Sternberg Astr. Inst., Moscow) and produced in Moscow under the direction of Dr. P. G. Kulikovsky, ex-president of Commission 41.

The issue for the year 1964 contains over 270 items. It includes a few references of earlier date omitted from the four previous issues, a policy to be followed in subsequent lists. The sixth contains over 100 items for the first half of 1965. The seventh issue covering the second half of 1965 lists some 280 items. In these three issues there are respectively one, five, and one, references to papers which appeared in the Journal of the R.A.S.C.

The present chairman of Commission 41, Dr. E. Rybka, in his Information Circular, February 1965, drew special attention to a book published in 1964 in Erevan on the history of Armenian astronomy by B. E. Tumanyan. It is written in Armenian with Russian and English abstracts, and covers the period since 7th century B.C. to the beginning of 19th century A.D. It includes descriptions of the Armenian calendar and the rich collection of astronomical instruments to which reference was made in my report on the Hamburg meeting of Commission 41 in this Journal, vol. 59, no. 1, 1965.

One meeting of this Commission has been held since Hamburg. The occasion was the 11th International Congress for History of Science held in Warsaw and Cracow in August 1965. Great appreciation was felt for the generosity of the Astronomical Council of the Academy of Sciences of the U.S.S.R. which has made possible the continuation of the publication and distribution of the *Bibliography*—a most valuable contribution to the work of all astronomers who are interested in the history of astronomy.

The Congress classified its contributors under five headings: general science problems, science of man, earth sciences, biological sciences, techniques and technical sciences. Of five symposia, three were of particular interest to astronomers: Traditional and Innovatory Elements in Cosmology of Nicolaus Copernicus (held in Torun where Copernicus was born and where the new Copernicus University and Observatory were established after the Second World War); The Work of Albert Einstein

(held in Warsaw); The Past and Future of Science (held in Cracow where the 600th anniversary of the University had recently been celebrated).

Amongst the large numbers of papers were 27 dealing with astronomical topics, 10 in the field of ancient and mediaeval astronomy and 17 with modern and contemporary astronomy. In the last category was the report by D. W. Watters on the restoration of the old Royal Observatory Greenwich (1675–1939), an historic site well known to many Canadian astronomers, first visited by the writer in 1922 when Sir Frank Dyson was the genial Astronomer Royal and Dr. John Jackson the friendly and humorous First Assistant.

The president of Commission 41 is gratified to learn that the Canadian National Committee of the I.A.U. has taken action to ensure that the history of astronomy in Canada will be recorded.

The next meeting of Commission 41 will be in Prague in August 1967.

THE XIII GENERAL ASSEMBLY OF THE I. A. U.

By A. Vibert Douglas
Kingston Centre

The General Assembly of the International Astronomical Union met in Prague on August 22–31, 1967. This historic and picturesque city lies on both banks of the Vltava river which runs north to merge its waters with those of the river Elbe. Praha, as the Czechoslovakian calls his capital city, has Stone Age antecedents. Today it is rich in Romanesque, Gothic and renaissance buildings, towers, bridges, churches, palaces and the vast complex called Hradcany Castle. It is all steeped in history, mostly a cruel and bloody record—Slavs and Huns invading from the east and Germans from the west; internal strife in the bitter Hussite wars, more recent absorption in the Austro-Hungarian Empire, then twenty years of free nationhood until the rape of Sudetenland and the agonies of the Second Great War.

Today these fine proud people are lifting their heads and looking west, east, north and south, asserting their identity, repairing their devastated or dilapidated buildings, constructing a subway in their capital city, creating new industries, increasing educational facilities, and inviting the outside world to come and meet with their people in city and country.

As hosts to the I.A.U. the Czechs were superb. Charles University, founded in 1348, provided accommodation. The stately Faculty of Law by the river was our Headquarters. The organization was excellent for dealing efficiently with some 2000 astronomers from over 30 countries, as well as many relatives. This number included some 35 Canadian scientists.

The public functions were held in the spacious Congress Hall for opening and closing ceremonies. The invited discourses were given on three evenings in the Lucerna, a huge underground auditorium with two balconies both below street level. The speakers were A. A. Mihailov

R.A.S.C. Jour., Vol. 62, No. 1 1968

(Exploring the Moon), P. Ledoux (Couches exterieures et structure interne des étoiles), M. Ryle and A. Sandage (Radio Galaxies and Quasi-stellar Sources).

Two evenings were made memorable by outdoor choral and orchestral concerts in the historic Ledebourg Terrace and in the spacious Wallenstein Garden. Music by Dvorac and by Smetena were, of course, included. A reception was given by the Government and the Academy of Sciences in Cernin Palace, Hradcany. Every delegate was presented with a ticket to an evening performance of folk dancing, the Black Theatre, or the exquisite opera-ballet in the National Theatre.

At the mid-week most members went on one of four possible tours to see something of western Bohemia or Brno or the lakes and caves near Prague. Bus trips enabled most astronomers to visit Ondrejov, 25 miles south-east of Prague, 1750 feet altitude, where solar and stellar work are carried on. The new 2-metre Zeiss reflector was officially opened on August 23 in the presence of the I.A.U. officers and Czech dignitaries.

Probably few astronomers failed to visit the old Tyn church where Tycho Brahe was buried near the high altar in 1601. A striking bronze bas-relief of this flamboyant Dane stands against a pillar nearby. Memories of Kepler are also awakened in Prague. In the Astronomical Exhibition in the Bellevedere high up across the river near Hradcany Castle many reminders of both these famous astronomers were shown.

The I.A.U. carries out its activities through 38 Commissions dealing with current astronomical problems, planning co-operation and the avoidance of wasteful overlapping. Frequently four or five or even eight of these were meeting simultaneously, so that one had to select some and miss many others. Much of the value of these gatherings is in the informal discussions at meals or over tea and coffee which our hosts made available throughout the sessions in the wide corridors.

In the paragraphs that follow a very few items are selected for mention, giving, it is hoped, at least some idea of the range and scope of the activities.

Commission 38 on the Exchange of Astronomers reported 51 grants to astronomers of 16 countries in the last three years. This number included a Czechoslovakian to Victoria, an Indian to Toronto and a Britisher to Kingston.

Commission 4 on Ephemerides reported the continued publication by H.M. Nautical Almanac Office, Royal Greenwich Observatory, of *The Astronomical Ephemeris*—for astronomers, *The Nautical Almanac*—for surface navigation, *The Air Almanac*—for air navigation, *The Star Almanac*—for land surveyors. Ephemerides published in U.S.S.R., Japan,

U.S.A. and other countries are co-ordinated with advance copies from H.M. Nautical Almanac Office.

Commission 7 on Celestial Mechanics rejoiced in the "new era" in this field resulting from the increased accuracy of observations due largely to radio-echo techniques and the developments in computer science. The "unprecedentedly important" revision of E. W. Brown's lunar theory by W. J. Eckert and his colleagues will unveil the past history of the moon. Refinements in satellite orbit theory call for further clarification of the nature of orbits with high eccentricities and inclinations.

Commission 10 on Solar Activity gave progress reports on four international projects dealing with the Quiet Sun, Isolated Active Regions, Proton Flares, and Rapid Variations of Solar Magnetic Fields. In addition a large spread of problems in solar physics was reviewed. Commission 12 dealt with radiation and structure of the solar atmosphere.

Commission 14 deals with Fundamental Spectroscopic data—a rapidly expanding field demanding "the coupling of astrophysical needs with laboratory programs". B. Edlen believes "an exceedingly useful secondary standard for length measurements" will be the He-Ne laser radiation with approximate vacuum wave-length λ6329.914.

The first session of Commission 15 on Comets included a fresh study of Comet Morehouse (1908), the rapid changes of its tail having puzzled astronomers for almost six decades. The solar wind plays a major part in the phenomena of the distribution of cometary dust, not only in this comet, for which 210 Greenwich plates provided the motions in and about the head, but also for Comets Mrkos (1957), Ikeya-Seki (1965) and others. Space observations are being made on artificial plasma clouds produced as high as 2000 km by rockets.

In Commission 16 on Physical Studies of Planets and Satellites, spectroscopic evidence was given for a tenuous CO_2 atmosphere about Mercury; the first ultraviolet spectrum of Venus was reported by D. Evans, but its interpretation as evidence for ozone is not certain; some conflicting evidence on the atmosphere of Mars ranged from N_2, CO_2 and A to an almost pure CO_2 atmosphere.

Radio studies have resulted in discovery of a 59-day rotation period for Mercury instead of the 88-day period heretofor accepted; a 10-cm radio emission from the solid surface of Venus; and radio emission by Uranus and Neptune.

A test of general relativity by the effect of solar gravity on the delay times for radar echoes from Mercury and Venus has been proposed by I.I. Shapiro.

Commission 17 on The Moon has had an exciting period both

observationally and theoretically. The multitude of close-up photographs Surveyor 1 radioed back by U.S.S.R. Luna 9 (Feb. 1966) and by U.S.A. (June 1966) and U.S.S.R. Luna 13 (Dec. 1966) from near or at the lunar surface has provided a mass of data giving evidence in favour of both volcanic and impact lunar features. On the floor of a large room a mosaic of 99% of the visible lunar surface was displayed under a sheet of plastic. In stockinged feet anyone could walk or crouch over this and study in detail any area of particular interest. The rows of shoes and sandals at the edge of the mosaic reminded one of the approach to an eastern Mosque, Temple or Shrine! These photographs, with a resolution of about 70 metres covering some 900 sq ft, were all taken by the U.S.A. Lunar Orbiter 4.

One item in the crowded report of Commission 27 on Variable Stars dealt with hot subluminous variables identified with variable quasi-stellar radio sources.

Commission 28 on Galaxies issued a 38-page report on progress in galactic studies including the detection of absorption lines in quasar spectra.

The 37-page report of Commission 29 on Stellar Spectra contained this sentence: "K. O. Wright (Victoria Observatory) has done the most accurate and extended work on line intensity standards which has ever been done."

Commission 31 on Time stressed the need for a new definition of the second but concluded the time is not yet ripe; that a frequency other than the one now used in caesium 133 (the transition between two hyperfine levels taken as 9,192,631,770 herz) may yet be found to be more stable.

Commission 40 on Radio Astronomy, established at the Zurich General Assembly in 1948, is now one of the most rapidly growing. Its president, Sir Martin Ryle, produced a 52-page report of progress and future developments, the section on instruments containing several references to Canadian installations. Three communications were made by Professor V. A. Hughes of Queen's University.

Commission 41 on History of Astronomy will be the subject of a subsequent paper.

The I.A.U. president for 1964–7, Prof. P. Swings (Belgium), has been succeeded by Dr. O. Heckmann (West Germany). The new secretary is Dr. L. Perek (Czechoslovakia). The Vice-presidents are from Argentina, Czechoslovakia, India, Italy, U.S.A., U.S.S.R. and West Germany.

In 1970 the General Assembly is to be held in Great Britain at the University of Sussex.

THE JOURNAL OF THE
ROYAL ASTRONOMICAL SOCIETY
OF CANADA

Vol. 57, No. 1 FEBRUARY 1963 Whole No. 460

TENTH INTERNATIONAL CONGRESS—HISTORY OF SCIENCE

By A. Vibert Douglas
Queen's University, Kingston, Ontario

Nearly 500 scholars from some 30 countries attended the opening of this Congress at Cornell University, Ithaca, N.Y. on August 26, 1962. On the afternoon of August 31 the Congress moved to Philadelphia and concluded with visits to the Franklin Institute, Academy of Natural Sciences and the Philadelphia Museum on September 2.

A total of 218 papers were listed in seven sections with concurrent sessions required: I, General Problems in the History of Science; Methods, Philosophy and Historiography of Science. II, History of Technology and Applied Science. III, Science in Antiquity. IV, Science in the Middle Ages and the Renaissance. V, Mathematics and the Exact Sciences after 1600. VI, Biological and Earth Sciences after 1600. VII, Sciences of Man (Psychology, Anthropology, Sociology, Linguistics).

Ten Canadians attended, of whom four presented papers: Professor Burke-Gaffney of Saint Mary's University, Halifax, on Pogson's Scale and Fechner's Law (see this Journal, p. 3); Professor R. V. V. Nichols of McGill University on Dr. Andrew Fernando Holmes, physician and naturalist, co-founder of the Montreal General Hospital and the Medical Faculty of McGill; Dr. W. E. K. Middleton of N.R.C. on Torricelli's part in the invention of the barometer; and the writer on some nineteenth-century Canadian books on scientific subjects, including what may be the first book written in Canada on astronomy, *God's Glory in the Heavens* (1862) by Principal William Leitch of Queen's University, Kingston.

A few papers of particular interest to astronomers will be mentioned. M. W. Makemson outlined old and new beliefs about the figure of the earth; Z. K. Novokshanova spoke on the construction of astronomical instruments in Russia in the nineteenth century; W. H. Venable discussed the important work of John A. Brashear (1840–1920) in producing the optical plates for Michelson's first interferometer.

In Section III, Asger H. Aaboe presented a study of the basic parameters in Babylonian astronomy referring to their computed planetary ephemerides for the last six centuries B.C. G. J. Whitrow discussed the concept of time from Pythagoras to Aristotle. In Section IV, Peng-Yoke Ho of Singapore University outlined the influence of Chinese astronomy, not only in Korea and Japan, but in Annam in the Middle Ages. S. Pines of Israel spoke on the Arabic Critique of Ptolemy's *Almagest* of Ibn al-Haytham, better known in the west as Alhazen. J. R. Ravetz examined the relations between precession of the equinoxes and the mediaeval and renaissance expression "motions of the eighth sphere". K. Yabuuti of Japan described the two Islamic books which show Greek influence (*Tables of the Seven Planets* are derived from the Almagest). These were brought into China in the thirteenth century as many Islamic astronomers settled in China following the Mongol invasion of several Asiatic countries.

C. Fischer and T. Przypkowski of Poland outlined the growth of astronomy in Slovakia from the fourteenth to the nineteenth centuries. J. W. Herivel gave an account of the development of Newton's concept of force "from its origin in the problem of collisions to its culmination in his solution to the problem of Kepler's motion". Karel Hujer discussed the history of Biela's comet and the origin of periodic meteors as first indicated by Schiaparelli in a letter to Father Secchi dated 1866.

The writings of Hevelius on sun-dials were the basis of a paper by T. Przypkowski; the work of the Turkish astronomer Taqi al Din (1575) on the orbit of the sun was compared with similar work by Tycho Brahe by Sevim Tekeli of Ankara. The two classifications of nebulae and clusters proposed by William Herschel in 1786 and 1802 were described by B. Sticker of Hamburg. The debt of classical physics to renaissance astronomers, particularly Kepler, was discussed by Edward Rosen of New York.

In order that historians of science might catch something of the "excitement of the chase" as experienced by the scientist in his search for answers to his queries, a special symposium was held at Cornell University on the discovery of the neutron and its effects upon physics. Edward Purcell (Cambridge, Mass.) gave the introduction: Nuclear physics without the neutron—Clues and contradictions. Norman Feather (Edinburgh) followed with a detailed account of the experimental discovery of the neutron. Emilio Segre (Berkeley) then delivered the George Sarton Memorial Lecture on the Influence of the Discovery of the Neutron on Nuclear Physics. Finally, as a delightful climax, a letter from Sir James Chadwick was read: Some personal notes on the search for the neutron. The concluding theme in this scientific saga was that the neutron is no longer an hypothesis but a tool—may we use it well!

THE JOURNAL OF THE
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XII INTERNATIONAL CONGRESS FOR THE HISTORY OF SCIENCE

A. VIBERT DOUGLAS
Kingston Centre

THIS Congress was held in Paris, Aug. 25–31, 1968. It brought together more than 700 historians of science from thirty-eight countries of five continents. The largest delegations were from France, U.S.A., U.S.S.R., Great Britain and the two Germanies. Canadians numbered fourteen of whom nine presented papers. Since there were some 400 papers in all, as many as eight sections might be going on simultaneously in morning and afternoon sessions. The sections included Science and Philosophy (Ancient, Mediaeval, Renaissance, XVII and XVIII centuries), Mathematics, Physics and Astronomy, Chemistry before XVIII Century, Earth Sciences, Biology, Sciences of Man, Scientific Instruments.

Eight colloquia had been organized on such topics as the origin of modern algebra, the development of the notion of structure in mathematical physics, spontaneous generation from antiquity to 1700, concepts and methods of psychological differential in the XIX century and at the beginning of the XX century, history of the philosophy of natural science.

The sessions were held in the spacious Conservatoire National des Arts et Métiers near Porte St. Martin. The opening reception was held in its museum of science and technology. The president of the Council of Paris gave a reception in the impressive Hôtel de Ville. On one afternoon bus trips were arranged to de Foquet's Château de Vaux-de-Vicomte and to Château de Chantilly. A banquet was held at the newly restored Château de Maison, and many delegates spent the last evening at a superb Soirée de Ballets at the Opéra-Comique.

Presiding at the opening and final sessions was the distinguished French academician Jean Rostand whose eloquence will not soon be forgotten. Not for nothing is he the son of a dramatist-actor.

About 30 papers dealt with subjects of astronomical interest. A few of these will be mentioned. J. D. North (Great Britain) discussed two astronomical treatises on the motion of the eighth sphere, based on the lost treatise of Walter of Odington, a monk of Evesham, throwing some light on the diffusion of astronomical knowledge in the Middle Ages. J. Dobrzycki (Poland) examined another theory of the eighth sphere, that of John Werner of Nurnberg published in 1522 and severely criticized by Copernicus two years later. H. L. Burstyn (U.S.A.) propounded his view that the four elements of Empedocles and Aristotle—earth, water, air, fire—did not offer a theory of matter as the alchemists assumed, but rather described the geospheres of modern physical geology—lithosphere, hydrosphere, atmosphere—and postulated a region beyond the atmosphere where solar phenomena dominate over terrestrial ones, roughly corresponding to what we designate as the inter-planetary medium.

Z. Dadic (Yugoslavia) discussed varying views on the figure of the earth as given by Patricius in Ferrara in 1591 and Dominis in Rome in 1624. W. Petri (West Germany) examined an ancient Armenian treatise of Eznik de Kolb (c. 448 A.D.) on the physics of the cosmos containing some early Greek and also Zoroastrian ideas as well as a discussion of lunar eclipses and atmospheric optical phenomena.

Three papers related to interesting celestial globes: M. Delombes (France) on the 1553 globe of Oronce Finé, professor of mathematics at the College royal de France; E. Pognon (France) on the globes of Père Coronelli (c. 1683) placed by Louis XIV first at the Château de Marly, then at the Louvre and now at Versailles; H. M. Wallis (G.B.) described this Franciscan monk, Coronelli, as the greatest globe maker of his age, the founder of the Academia degli Argonauti in Venice which ranks as the earliest of all geographical societies. Coronelli's celestial and terrestrial globes range from two inches in diameter to the fifteen foot pair made for Louis XIV.

P. Collinder (Sweden) gave an account of distance evaluation in antiquity, especially the Nile-distance of Eratosthenes which he believes was most probably derived from innumerable day's sailings on that most-navigated of rivers, the final result given by Cleomedes having an error of about 16 per cent.

W. F. Cannon (U.S.A.) described the work of John Herschel as physicist. His investigations in the 1820's on solar radiation mark the beginning of quantitative astrophysics, his "actinometer" was the pioneer of today's pyrheliometers.

W. H. Brock (G.B.) spoke of Sir Norman Lockyer and the chemists

who looked with suspicion on his postulation of an element, helium, and his "working hypothesis" that stellar spectra indicated that elements were dissociated in the sun. His sternest yet most helpful critics were Crookes, Armstrong and Roscoe, as is evident from the reading of unpublished correspondence.

O. Gingerich (U.S.A.) has probed into the heliocentric vs. the heliostatic in the Copernican system, concluding that the latter is true but not the former in the Copernican universe.

G. J. Whitrow (G.B.) compared and re-assessed the Nebular Hypotheses of Kant and Laplace in the light of present knowledge and ideas.

Z. Horsky (Czechoslovakia) presented a philosophical study of ideas of living matter and inert matter in the XVI and XVII centuries, with reference to Copernicus, Patricius, Bruno, Kepler and Galileo.

T. Hirosige (Japan) discussed the decline of the ether as seen by Lorentz, Einstein and Minkowski. M. Kapek (U.S.A.) examined the work of Bozcovich, 1755, and Stallo, 1881, as critics prior to Mach of Newton's absolute space and absolute motion.

C. D. Hellman (U.S.A.) warned against uncritical study of XVI century manuscript material on novae and comets. C. S. Rousseau (U.S.A.) examined the relation of poetry and astronomy in the English Enlightenment, 1660–1800, when the influence of astronomy was the most important among the sciences. K. Hujer (U.S.A.) discussed the influence of Nicholas of Cusa on the rise of new astronomy.

Two papers were given by curators of the National Maritime Museum, Greenwich. H. D. Howse described the restoration of the old Royal Observatory and D. W. Waters outlined the methods of longitude measurements from 1415 to 1767.

E. Rybka (Poland) reported on the proposal of the XIII General Assembly of the International Astronomical Union that a synthetic history of astronomy be undertaken, an international monograph based on the results of original research. It would show the interdependence of the development of astronomy and other sciences, and the influence of intellectual surrounding on the development of scientific ideas. The question arises as to whether it should come only to the beginning of the XX century, or to the contemporary epoch. Dr. Rybka is chairman of Commission 41 of the I.A.U.

Of the nine papers contributed by the delegates from Canada three have astronomical interest. Rev. Professor M. W. Burke-Gaffney (Halifax) recounted the first identification of lines in Comet 1882 II as due to iron atoms and the confirmation of this in the spectrum of comet 1965f. S. Drake of the Department of History (University of Toronto)

discussed the origin of Galileo's ideas on circular inertia. The writer of this article presented a paper on the historical significance of the 1226–27 conjunctions, making an excursion into the labyrinthine realms of astrology in order to account for the significance attached to these astronomical events.

Since the conference had convened only a few days after the invasion of Czechoslovakia there was a palpable tenseness in the air and a pall of shock, indignation and sadness hung over the assembly. Delegates were present from all the eastern European countries and to the writer's knowledge some of these, even one from the U.S.S.R., apologized to a Czech delegate for what his country was doing to a fellow member of the Warsaw Pact. At the final session just before the chairman declared the Congress closed, one delegate rose to propose a vote of sympathy for our colleagues the savants of Czechoslovakia. This was passed without opposition, the only abstentions being those delegates who would not or dared not be seen voting for it.

It was common knowledge that the incoming president was from the U.S.S.R. and that the next congress had been invited to meet in Moscow, but so great was the indignation over the crushing of Czechoslovakia's bid for some measure of freedom that the congress ended with no decision as to the locale of the 1971 meetings.

p. 108 - IUHPS Report

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THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

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ABOUT OUR AUTHORS

We are happy to extend a welcome to three authors new to these pages.

A. J. MOREHOUSE earned his B.Sc. in 1963 at the University of Oklahoma and at present is studying variable stars classified as type "?" by GCVS, using the facilities of the James C. Veen Observatory at Lowell, Michigan, as well as the Michigan State University Observatory in East Lansing.

J. G. FREEMAN retired in 1971 from the University of Bradford, England, as Emeritus Professor of Mathematics. Previous to this he was Senior Lecturer in Mathematics at the Royal Aircraft Establishment Technical College at Farnborough. Dr. Freeman received his M.A. in Mathematics from Oxford University in 1935 and his Ph.D. in Differential Geometry from London University in 1943. He computed ephemerides of comets for the Handbook of the British Astronomical Association for a number of years, is a member of the B.A.A., a Fellow of the Royal Astronomical Society and a Fellow of the Institute of Mathematics and its Applications. His professional interest lies in research in Finsler and Generalized Metric Spaces. Astronomy is a hobby with Dr. Freeman, coupled with fell-walking, organ playing, photography and radio construction.

A. A. BARRETT is Associate Professor in the Classics Department of the University of British Columbia and a member of the Vancouver Centre of the R.A.S.C. He was born in Sussex, England, receiving his B.A. from the University of Durham, his M.A. and Ph.D. degrees from the University of Toronto, the latter in 1968. Dr. Barrett is the author of several papers on ancient history and archaeology and is interested in the empirical aspects of Greek astronomy. At present he is doing research on the geographical works of Ptolemy the astronomer. We should mention that Dr. Barrett was a Commonwealth Scholar while at the U. of T., is a former Secretary of the Classical Association of Canada and is now the western regional representative on the executive of the Humanities Association of Canada.

MARIE FIDLER

NOTES

XV International Congress of the History of Science

About 900 scientists and historians of science from 39 countries met at the University of Edinburgh from 10–19 August, 1977, for the triennial congress of the International Union of the History and Philosophy of Science. It is good to see the growth of interest in Canada in the history of science; instead of a mere handful, we had 23 registered participants at this congress. It was also pleasing to see delegates from countries such as Cuba, Zaire and Saudi Arabia.

The Pollock Halls of Residence, under the shadow of Arthur's Seat, afforded good accommodation and a mile away the modern Appleton and David Hume Towers, adjacent to the old George Square of the University, provided a spacious reception centre and lecture theatres for the many sections of the programme. A warm tribute is due to the Organising Committee whose chairman and secretary were R. V. Jones, F. R. S., Professor of Natural Philosophy, Aberdeen, and E. G. Forbes, Reader in History, Edinburgh, respectively.

The first of ten symposia was on "Science and Human Values", chaired by Dr. Joseph Needham of Cambridge. His opening address stressed the modern suspicion of science. Following this, Dr. J. R. Ravetz of Leeds quoted Galileo, Bacon, Descartes and Popper in support of his view that the high optimism which prevailed before and throughout the Victorian era, i.e. the belief that scientific progress and human betterment went hand in hand, has given place to a deep suspicion of science in this century because science is now conferring "power without responsibility".

Subsequent symposia dealt with "Internal and External Causation of Scientific Ideas", "International Cooperation and Diffusion in Science", "Medicine and Industrialization in History", "Physics and Metaphysics in the Scientific Revolution", "Aspects of the History of Thermodynamics: Theory and Practice", "Problems of Source Materials in the History of Science", "Relations between Theories of Heredity and Evolution (1880–1920)", "Classification and Systematisation in the Sciences", "Cosmology since Newton", and an added symposium on "Human Implications of Twentieth-Century Communications Technology". All the papers at these symposia were given by invited speakers.

At the same time, as many as seven other meetings might be in progress where one could hear and discuss papers on science and technology in antiquity, or from antiquity to 1600; on developments since 1600 in mathematics and mechanics, physics and astronomy, chemistry and pharmacy, biological and medical science, earth sciences, technology and engineering, history of sciences of man, science and society; and on problems of philosophy, methodology and historiography.

Some papers of special interest to astronomers may be mentioned. Dr. A. A. Al-Daffa of Saudi Arabia presented a paper on the "father of algebra", Al-Khwarizmi (780–850), the Court Astronomer at Baghdad. From the title of his work *Al-Jabr* comes our word algebra. According to Dr. Al-Daffa, he "transformed number from its arithmetical character as a finite magnitude into an element of relation and of infinite possibilities ... a step from 'being' to 'becoming'." To serve practical needs "he applied algebra to matters of inheritance, legaciers, partition, lawsuits and commerce".

Soviet perspectives on Giordano Bruno (1550–1600), which have been overlooked by western scholars, were summarized by F. Hamlyn Dennis (London). These include Bruno's suggestions in 1591 of the existence of other planets in the solar system than the six known ones, of the rotation of the sun and stars around an axis, and of the existence of innumerable bodies similar to our sun. Also mentioned was Bruno's opposition to anthropocentrism.

K. D. Mathur (U.K.) discussed the origins of Indian astronomical observatories as connected with accurate determinations of time for religious ceremonies in the Vedic period, *c.* 1500 B.C. In addition, he spoke of the great reconstructive activity of Jai Singh in the early 18th century under the Mogul emperor's instructions.

Fouad Aintabi (Syria) outlined the indebtedness of the first professor of astronomy at Oxford, John Greaves, to Ibn Yunus (950–1009), an Arab astronomer who contributed to the study of solar and lunar eclipses and to both plane and spherical trigonometry.

E. G. Forbes (Edinburgh) has located hundreds of letters from and to the first Astronomer Royal, John Flamsteed (1646–1719), including correspondence with G. D. Cassini and, in Latin, with Johannes Hevelius of Danzig. Owen Gingerich (USA), continuing his dedication to Copernicus and *De Revolutionibus*, discussed sixteen copies, presently in Scottish libraries, of the 1543 and 1566 editions with special reference to the two copies in Edinburgh, one of which belonged to Adam Smith. These were both richly annotated in Wittenburg in the early years of publication.

K. M. Pedersen (Denmark) reviewed the 1782 paper of Patrick Wilson of Glasgow who demonstrated the constancy of stellar aberration by comparing the effect obtained using an ordinary telescope with that observed when the telescope tube was filled with water. S. D. Sharma (India) claimed that the Indian astronomer Ketkara had made the first accurate predictions of Pluto and had also predicted a smaller planet beyond Pluto. His calculations had been based on cometary orbits, especially that of Halley's comet of 1910, after which he wrote to Flammarion giving the positions. For the larger planet, his predicted distance of about 39 AU and period of 242 years

agreed remarkably well with the values of 39.44 AU and 247.7 years determined after the discovery of Pluto in 1930, twenty years after Ketkara's prediction. For the smaller, planet X, his prediction was a period of 458 years and distance of 59 AU. Sharma has calculated the present position of planet X using the constants of Ketkara and some recent data used by Dr. Brady of California who is likewise interested in a transplutonian planet.

R. W. Smith (London) spoke of the 1910–30 period when speculation ran riot as to the nature of spiral nebulae with reference to the Milky Way system. In this connection, letters between Ejnar Hertzsprung and Eddington, written in 1916–17 and recently discovered at the University of Aarhus, throw light on their thinking. In the discussion which followed this paper and in the cosmology symposium on the following day, it seemed appropriate to remind the young speakers that as early as 1914 Eddington had made his own position very clear in his *Stellar Movements and the Structure of the Universe*, namely that the spirals were themselves galaxies completely outside our Galaxy; only by adopting this hypothesis did he see any prospect of progress.

M. A. Hoskin (Cambridge) opened the cosmology symposium with a review of eighteenth and nineteenth-century thinking about the solar system, the number of stars and the nature of nebulae and star clusters. J. A. Bennett (London) spoke of the part played by the great reflectors of Herschel and Rosse which raised new questions. N. S. Hetherington (USA) carried the story into the present century with its tremendous technical developments and wealth of new knowledge, which Shapley, Hubble, Oort and others helped to interpret. The advent of radio astronomy opened an entirely new chapter of astronomical observation, both complementing and extending what optical instruments had achieved. The interpretation of all this new knowledge was discussed by G. J. Whitrow (London), who outlined several phases in the development of theoretical cosmology. The first began with Einstein in 1917, and led to de Sitter's solution. Then in 1922 and independently in 1927 came the models of an expanding universe of A. A. Friedmann and Georges Lemaître, developed further by H. P. Robertson from 1929–33. New avenues were opened up by E. A. Milne, Dirac and Eddington. A yet different approach was made by Hoyle, Bondi and Gold in 1948 with their "steady state" hypothesis. Only as observations penetrated deeper and deeper into space in the nineteen-sixties did evidence accumulate against this and in favour of the evolutionary universe. And so the quest for a more fully satisfactory theory goes on and on, and will continue to do so as long as new knowledge poses new questions.

Two special events must be mentioned. An opening public lecture by

Professor Trevor-Roper (Oxford) entitled "The Scottish Enlightenment" drew attention to the remarkable period when the fame of great thinkers like Adam Smith, Thomas Carlyle, James Simpson and others of similar stature drew the eyes of all Europe to Scotland as the intellectual centre of the western world. Finally on a subsequent evening in St. Cecilia's Hall, a fortunate minority of us were delighted with three compositions by Mozart, Borodin and Dvořák beautifully performed by the Edinburgh Quartet.

A. Vibert Douglas
Kingston Centre, R.A.S.C.

A Possible Historical Association Between a Dollond Telescope and Early Scientific Surveys in Canada

The Dollond refractor and alt-azimuth mount shown in figure 1 may have some interesting associations in the development of science in Canada. It was obtained at public auction in Ottawa as part of a consignment from a government warehouse in Quebec City. Other items in the same consignment were a rare, framed map of Upper and Lower Canada *circa* 1840, a rifle, an oil lamp and a fur greatcoat.

The telescope has an aperture of two inches and a length of 42 inches, with "Dollond" inscribed on the eyepiece draw tube. Even though the thread used to fasten a brass collar of the objective cell to a mahogany tube is missing, the optics of the telescope are in good condition and have been tested on Jupiter. Shortly after it was purchased, the article "Origins of Canadian Government Astronomy" by R. A. Jarrell (this Journal, **69**, 77, 1975) reported that a 42-inch Dollond telescope had been used by Commander E. D. Ashe in the establishment of the Quebec City Observatory in 1850. Since this was the length of the one I obtained, it seemed reasonable to assume that the instrument shown in figure 1 may have been the one belonging to Ashe. However, such telescopes were reasonably common, and it seemed curious that the one in my possession was not astronomically mounted. In order to test further this possible association, I was referred by Jarrell to the account[1] of the solar eclipse of 1869, observed and described by Commander Ashe, in which he mentions two instruments – one a 42-inch Dollond refractor and the other a telescope of eight-inch

[1] *Proceedings of the Canadian Eclipse Party 1869*, Commander Ashe, Middleton and Dawson, Quebec 1870. The copy in the library of the National Office of the R.A.S.C. was presented by G. E. Lumsden, one of the incorporators of the "Astronomical and Physical Society of Toronto" in 1890. This copy also has the inscription "Mr. Langton from E. D. Ashe".

FIG. 1—The author with the 42-inch Dollond telescope. The name "Gordon Watson" is scratched on the mahogany tube, just above the mounting point. This instrument was consigned for public auction from a government warehouse in Quebec City.

aperture and nine-foot focal length. A photograph of these at the eclipse site (figure 2) shows that both had polar mounts and indicates that my hastily made assumption was incorrect. I was left, furthermore, with the puzzle of identifying the name "Gordon Watson" neatly scratched in the varnish of the mahogany tube.

In reading accounts of the early days of the Toronto magnetic observa-

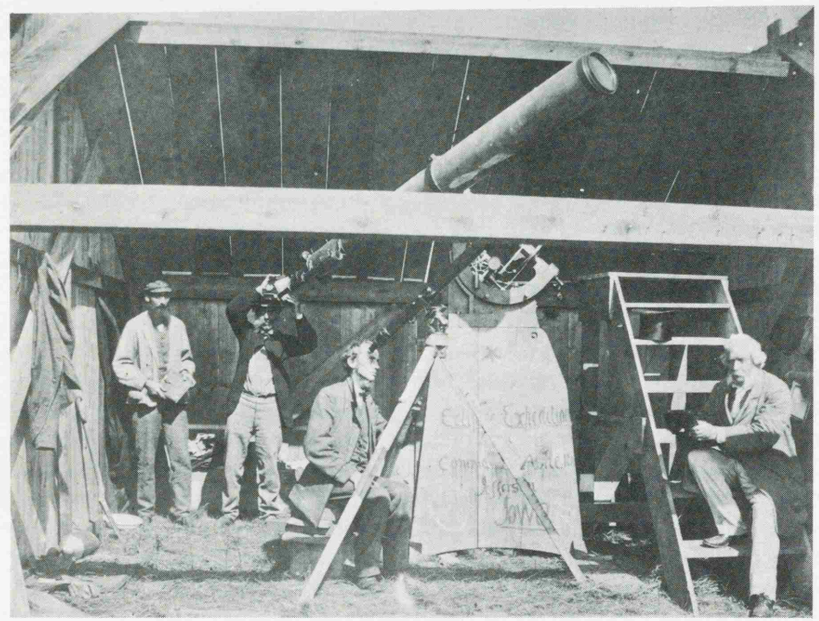

FIG. 2—The 1869 eclipse party, organized by Commander Ashe, at Jefferson City, Iowa. The two telescopes are from the Quebec Observatory and are described as a "42-inch Dollond" and an "8-inch aperture and 9-feet focus".

tory, I have encountered the name "George Watson", leading me to speculate upon a possible connection between the above telescope and the Toronto observatory. The establishment of the Toronto magnetic observatory in 1839 is described in a series of articles in this JOURNAL, commencing in Vol. **34**, p. 308, 1940, by A. D. Thiessen. This venture was part of a world-wide program to study the earth's magnetic field and its variations following a series of recommendations, letters and petitions from Baron von Humboldt; Major Sabine, Superintendent of the Colonial Observatories at Woolwich, England; the President of the Royal Society London; and the British Association for the Advancement of Science. The main expedition to establish an observatory in Canada, under the direction of Lieutenant C. J. B. Riddell, passed through Quebec City en route to a preselected site in Montreal. However, upon arrival at Montreal in the fall of 1839 tests showed that this whole area was unsuitable for a magnetic observatory. The party then proceeded to the unused barracks of Old Fort York in Toronto and established the initial observatory there. In the letters relating to the Toronto observatory, published in the articles by Thiessen,

references to Gunner George Watson, 2nd Battalion Royal Artillery, and his family occur several times; the last ones, in 1842 (this JOURNAL, **35**, 205, 1941), report that he was ill and that his family had been cut off from "the ration list". He was finally separated from the undertaking and his subsequent movements are not recorded.

This account is presented in the hope that further details may be found elsewhere which may establish whether or not a relationship existed between the two Watsons with the same initial. Until then, it is pleasant to entertain the possibility that at some time, a younger Watson with the same initial as that of his father scratched his own name on the telescope. Ultimately, the issue of a fur greatcoat, map, rifle, oil lamp and telescope were returned to stores and only recently have they been auctioned off. Regardless of the final identification of the telescope, the image of this equipment and its possible use brings to mind the conditions under which a major scientific enterprise was conducted in a young country. The magnetic observatory which finally was established in Toronto was operated for a number of years before being transferred to Agincourt where operations were conducted for another 70 years. Sir Edward Sabine combined the early data with that obtained from the southern-hemisphere observatory in Hobart, Tasmania, and was able to correlate an eleven-year cycle of magnetic variations with the newly discovered sunspot cycle.

ARTHUR E. COVINGTON
Chairman, R.A.S.C. Historical Committee

MEETING OF THE N.R.C. ASSOCIATE COMMITTEE ON ASTRONOMY

The fourteenth meeting of the Associate Committee on Astronomy, comprising a representative cross-section of Canadian government and university astronomers, was held at the Université de Montréal on November 18, 1977, chaired by Dr. Ian Halliday. This advisory committee, which also serves as the Canadian National Committee for the International Astronomical Union (IAU), has two main concerns at the moment: the organization of the XVII General Assembly of the IAU, to be held in Montréal from August 14–23, 1979; and advisory activities in connection with the construction of the Canada-France-Hawaii Telescope on Mauna Kea, on the island of Hawaii.

Under the direction of Dr. Alan Batten, the National Organizing Committee for the upcoming IAU General Assembly seems to have the monumental task of arranging a nine-day meeting for over 2000 astronomers well in hand. This will be the first time that such a meeting will be held in Canada (the third in North America since the founding of the Union in 1919) and will

certainly bring the foremost astronomers from around the world to Montréal. Most of the meetings of the General Assembly will be held at the Université de Montréal and during the November meeting of the Associate Committee we were treated to a tour of the magnificent facilities that will be used in 1979. In addition to the General Assembly in Montréal, several IAU Symposia will be held in Canada and the U.S.A. during the summer of 1979. Topics of planned symposia in Canada include "Turbulence in Stellar Atmospheres" (London), "Interstellar Molecules" (Ottawa), "Close Binary Systems" (Toronto) and "Star Clusters" (Victoria).

Members of the Associate Committee also heard progress reports on the construction of the CFH Telescope and its auxiliary instrumentation. Dr. D. A. MacRae noted that the Board of Directors of the Canada-France-Hawaii Telescope Corporation were considering the town of Waimea as the site for the Corporation headquarters. Waimea is in ranching country close to the north-west coast of Hawaii. Dr. J. L. Locke reported on the delays encountered in the construction of the telescope structure at La Rochelle, France, and told members that the building and dome are now ready to receive the telescope when it arrives. Dr. W. H. Wehlau reported that the CFHT aluminizing system on Mauna Kea is essentially operational. In fact, it will be first used to aluminize the mirror of the British infrared telescope which is also being built on Mauna Kea. Dr. Locke also told of the progress being made at Victoria in the figuring of the primary and secondary mirrors and in the construction of the spectrograph (No. 1) for use at the prime and Cassegrain focuses.

Other topics of interest at the Associate Committee meeting were the announcement of the funding of a feasibility study, at U.B.C., for a Canadian space telescope, and the transfer from the Associate Committee to the Canadian Astronomical Society of the advisory sub-committees for Radio Astronomy and for Education. Members were also very pleased to hear Dr. R. Racine report that l'Observatoire astronomique du Québec (at Mont Mégantic) is nearing completion with "first light" expected around May 1st.

L. A. HIGGS

NOTES FROM OBSERVATORIES

DOMINION ASTROPHYSICAL OBSERVATORY, VICTORIA, B.C.

Dr. S. van den Bergh joined the staff as Director in January, 1978, after frequent visits during the preceding months. We welcome him, and Dr. J. E. Hesser, who has also joined the staff, after several years at C.T.I.O. Dr. R. H. Poeckert began tenure of a research associateship in October, and W. A. Grundman began work in the engineering-drawing department in September. T. Wescott left one of the night-assistant positions in December. Visitors and colloquium speakers in the past six months have included M. Ward (Sussex), J. McClintock (M.I.T.), D. Harris (D.R.A.O.), G. Bath (Oxford), H. Schnopper (Harvard), R. Bochonko (U. of Manitoba), B. Campbell (U.B.C.), and C. R. and A. P. Cowley (U. of Michigan). M. Rolston and T. Farley have joined the staff, as draughtsman and secretary respectively, on the 1977–78 winter-works program.

The CFH Telescope primary mirror underwent its acceptance tests in October. Preliminary results suggest that it should meet specifications. Work is now proceeding on the secondary. The secretarial staff have been equipped with a MICOM typing and editing system. The UBC reticon detectors have been used both in the coudé, and at the 72-inch Cassegrain, for UBC and joint UBC-DAO programs. The UBC-DAO photon-counting system has been fully tested in laboratory conditions and now awaits interfacing to an image tube or CCD detector. C. Morbey has acquired a remote terminal to the U. of Victoria computer for use in optical design work by E. H. Richardson. Richardson and Grundman have worked on a conceptual design for a large telescope array, and D. H. Andrews and G. A. Brealey have worked extensively on spectrograph design for the CFHT. The duplicate CFHT control computer has been delivered and will be used for spectrograph software development and hardware testing. The computer system for the eight-channel photometer has also been delivered.

Some current observational programs have included the recent outburst of CH Cygni (Morris), rapid variations in Be star spectra (Poeckert), X-ray sources in the Magellanic Clouds (Crampton, Cowley, Hutchings), rotating and β Cephei stars with the *Copernicus* satellite (Hill, Hutchings) and high-resolution imaging of galaxies with the 2-D reticon (Pritchett).

J. B. HUTCHINGS

INFORMATION FOR AUTHORS

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The International Federation of University Women and Scholarly Research—(No. 2—1953)

by

A. VIBERT DOUGLAS, M.B.E., Ph.D., F.R.A.S.

Past President, I.F.U.W., and Convenor of the Committee for the Award of International Fellowships

Dipping into history

The International Federation of University Women, established in 1919, has always emphasised the encouragement of scholarly research. It was realised that too few opportunities existed for young women with proven research ability to pursue their work in a country other than their own; and that only by so doing would they attain the degree of eminence in scholarship which might make them eligible for promotion to senior appointments.

The I.F.U.W. Council in 1923 adopted a resolution proposed by Dr. Smedley MacLean that a fund be raised to provide international fellowships and prizes. In 1924 this fund was established, the first gift being of great significance and unusual interest. It was reported to the Council by Dr. Gleditsch that in 1913 a group of elderly Norwegian men met to celebrate the 50th anniversary of their graduation and decided to collect some money for a research fellowship to be given to a woman—two thousand kroner had been collected when the war came, and their plan was abandoned; but in 1924 the surviving members of the group decided to hand over the whole sum to the International Fellowships Fund of the I.F.U.W. This gracious act was an inspiration, and by 1926 contributions had been made by eleven National Federations. The funds slowly accumulated until in 1928 the first award of a Fellowship, valued at £250, could be made. The final £1,000 of the endowment fund was placed in the hands of Professor Winifred Cullis, then President of the Federation, at the Prague Council meeting of 1930 by President Masaryk as his personal contribution to an international project the value of which he fully appreciated.

A few years later, the American Association of University Women (A.A.U.W.) endowed two fellowships to be awarded by the I.F.U.W., one known as the Crusade Fellowship, the other named after Mary E. Woolley. Subsequently they have endowed several others for annual or less frequent award by the I.F.U.W., namely the Ohio State, the Helen Marr Kirby, the Virginia C. Gildersleeve and the Alice Hamilton. In various other countries the National Federation has from time to time raised one or more fellowships for international award in a particular year, e.g., Australia, the Netherlands, Denmark.

In addition to these full fellowships ranging in dollar value from $1,250 to $1,680, many bursaries and grants have been awarded to professional women for special research projects.

The total amount awarded in international research fellowships and grants to May 31st, 1953 is over £80,500. This figure includes the international fellowships and grants awarded by the I.F.U.W. and by individual National Associations of University Women. It does not include fellowships and scholarships which the National Associations have awarded within their own countries to their own scholars.

The I.F.U.W. Fellowship

The I.F.U.W. Fellowship has been awarded twenty-four times, and twice in the early years it was divided between two applicants. The first recipient, in 1928, was a Swiss biologist who spent the year in Berlin on research in genetics. Three years later she was awarded a grant by the Carnegie Institute and went to Baltimore. Her studies led into the medical field and since 1940 she has been Chief Assistant in histology and embryology at the Medical School of Geneva. Her researches are recorded in more than twenty published papers. In a recent letter this scholar expresses the hope that all I.F.U.W. fellowship holders may find the joy and pleasure as well as the benefit in their careers that the 1928 I.F.U.W. award gave her.

The Fellowship went to a Netherlands botanist in 1930. She worked on plant diseases in California and subsequently attained professorial rank in the University of Pretoria. Two other Dutch scholars have held it, one in archaeology, and one for research in Celtic literature, particularly the Arthurian legends.

In 1941 a Swiss mathematician of outstanding ability received this award and has proved to be a prolific scholar. She is on the university staff at Neuchâtel. In her special field, the theory of groups, she has published some fifty-four papers over the last twenty-three years.

A Polish biochemist worked at Cambridge University on the chemistry of heart muscles as part of a team of workers on rheumatic heart conditions, and has remained there in productive research activities for over a dozen years.

An Indian scholar, a Benares graduate, did valuable research in early mathematics, producing a critical edition of the Khandakhadyaka of Bramagupta (A.D. 598) for several partial editions of later dates which are in the British Museum and the Bodleian Library, Oxford. This ancient Sanskrit work contains astronomical formulae, geometry, and the first known application of the principle of interpolation in mathematical literature. This scholar is the only woman to date to receive a second fellowship from the I.F.U.W. Committee, when in 1942 she was given the Ohio State International Fellowship. She is now an Adviser in the Ministry of Education in India. Another Indian, a palaeobotanist from Nagpur University, has received the I.F.U.W. fellowship for 1953-54 to continue at Reading an investigation of microflora associated with the coal deposits of India.

Other holders have been an Austrian radiologist; from Australia a petrographer, an economist, a chemist who worked on the problems of cancerous tissues, and a soil bacteriologist; from Britain a mediaevalist who went to Austria and Italy, a geologist who went to Arabia, a mineralogist who studied kaolin clay at the Massachusetts Institute of Technology (M.I.T.) in Boston, and a specialist in economic history. A Dane went to Rome to study epic verse of the time of the Empire; a Swede pursued research on the religious art of Scania; a French archaeologist made investigations in Ireland, Scotland and Scandinavia; a Canadian studied Coleridge manuscripts in Britain and is now on the faculty of Toronto University; and a German scholar went to India to investigate some aspects of art and customs.

The Crusade Fellowship

The Crusade International Fellowship has been awarded ten times, beginning with a German bacteriologist in 1934. There followed a Hungarian botanist who went to the U.S.A., a German philologist and a Norwegian scholar of linguistics both of whom went to France, an Indian organic chemist who obtained her doctorate at the University of Cambridge and returned to become a nutrition expert in India, an American biochemist who went to England, a Polish biologist who did valuable research on fruit grafting in Great Britain, a Dutch scholar of middle eastern language and literature who went to Iran and on her return was appointed Professor of Persian Studies at Utrecht, an Italian biochemist, an Australian zoologist who went to Oxford to work on marine plankton.

The Mary E. Woolley Fellowship

Awarded for the first time in 1940, this fellowship has also been given ten times. The first holder was a scholarly Russian refugee who worked in London on the social philosophy of Dostoievsky. Then followed a South African historian, and an Indian scholar who examined the unpublished drawings and writings of William Blake which are in libraries and private collections in the U.S.A. and interpreted these in relation to Indian symbolism and mysticism.

A German born but English trained physicist, now a British citizen, went to Canada to work on neutron diffraction; a German authority on mediaeval musical manuscripts and incunabula, now an American citizen, made a list with classification and appraisals of all such scores in the great libraries of Great Britain, France and America to round out her earlier work in Germany and Austria.

Others holding this fellowship have been a Dutch philosopher who studied classical inscriptions and papyri at Harvard, a zoologist from Israel investigating a special species of fly in Berkeley, California, a Canadian zoologist who went to the University of Cambridge, an Austrian archaeologist who is making exciting discoveries in Etruscan sepulchral art and archaeology in Italy, and the 1953-54 award has gone to a Dutch plant physiologist who will go to California to the Earhart Laboratory to study the effect on plant behaviour of controlled temperature, humidity and illumination.

The Ohio State Fellowship

This fellowship, first awarded in 1942, has likewise assisted ten scholars, the first of whom was the Indian student of Sanskrit mathematics already referred to. Other holders were Swedish and Danish philologists and a Danish historian of sculpture specialising on Thorvaldsen, a French chemist who went to the Harvard Medical School, an Argentinian chemist and pharmacist who went to Columbia University, New York, and a Dutch crystallographer for work at Oxford.

An Australian anthropologist and her husband went to New Guinea and have carried out a remarkable piece of team-work in studying tribal customs, secret rituals of initiation of boys and of girls, taboos and beliefs.

An Austrian biologist has studied the cycle of certain lake fauna in both southern Sweden and far north in Lapland; and an Australian physical chemist holds the 1953-54 award for research on the kinetics of reactions of some organic compounds for which work she plans to go to Toronto University.

The Helen Marr Kirby Fellowship

This fellowship has been awarded ten times, beginning in 1944. A zoologist from the University of Jerusalem went to California, then a British scholar crossed the Channel to work on French literature. The next was a Dutch biologist who worked in California and likewise an able botanist from Israel; then a Belgian archaeologist did a study of Egyptian law from papyri in Cairo, and next came two Australians—one in eighteenth-century farce in English literature and one in economic history.

Subsequently a British anthropologist undertook tribal studies in British Guiana, then a Canadian physical chemist worked on the crystal structure of some boron-nitrogen and hydrocarbon compounds in the laboratory of Professor Kathleen Lonsdale in London. The 1953-54 award is held by a distinguished Austrian whose work on the history of art and of early mediaeval buildings fits her admirably to study the "lectorium" in Europe.

The Virginia C. Gildersleeve Fellowship

This fellowship, named in honour of one of the founders of the I.F.U.W., its second and also its sixth President, was first awarded in 1946 and has been held by seven scholars. The first holder was an English botanist who after six war-time years interruption of research went to Minneapolis to study bogland flora. Then a Danish scholar pursued her work on microfauna of Arctic regions in the U.S.A., and a Swedish scientist did medical research in Philadelphia; a Norwegian crystallographer worked in London; an archaeologist from the Netherlands visited many parts of India investigating temples and religious sculpture.

A Norwegian astrophysicist who had held an A.A.U.W. award the previous year at Mt. Wilson received the Gildersleeve Fellowship to enable her to spend a year working on the theoretical problems of cosmic magnetism under the guidance of a distinguished Indian astronomer at Yerkes Observatory, Wisconsin. The 1953 award has gone to a Danish archaeologist whose studies of late B.C. and early A.D. Iron Age in Scandinavia will now be extended to the Anglo-Saxon Iron Age.

The Alice Hamilton Fellowship

This fellowship has been awarded twice. The first holder, in 1950, was a New Zealand physiologist who went to Cambridge to investigate problems of nutrition. In 1952 the award went to a Swiss biologist who studied the life cycle of an important tropical parasite in Puerto Rico.

The Marion Reilly Award

Established by American generosity in 1941, this grant of $500 to $1,000 has enabled eight scholars to continue work on their research problems. It enabled an Argentine dentist to continue investigations on children's dental deficiencies in Brazil, a British scholar to complete a book on Italian and French influences on Elizabethan literature, a Swede to work on Saint Honorat in Paris and Tours, a Dutch archaeologist to carry through her work in Chicago. It went in 1948 to an Italian archaeologist, and in 1951 to a Canadian sociologist to investigate the workings of national health insurance in England. In 1953 one grant has been made to a distinguished Italian entomologist to enable her to examine the collections of Hymenoptera in the British Museum; and another grant has gone to a Latvian scholar who has found temporary refuge and good friends in Switzerland and has carried on some valuable researches on French Gothic cathedrals and sculpture—she will develop her comparison of classical and Gothic sculpture in Paris.

Other Fellowships and Grants

In 1950 the Danish Gratitude award enabled a scholar of Scandinavian literature to go from England to Copenhagen. Two Australian international fellowships have been awarded by the I.F.U.W., one in 1949, the Constance Ellis award, took a British physicist to Leiden to work on the low temperature properties of helium; another in 1952 took a mineralogist from Great Britain to Melbourne, Australia for a study of the genesis of clay minerals. The Netherlands international award enabled a Norwegian teacher who had made extensive studies in the economic history of Bergen to spend a year in Holland following up trade records with the Low Countries.

There have been many other awards besides those made by the I.F.U.W., but these and other national awards pass through their own National Associations, not through the I.F.U.W. Committee, so no details are included in this paper.

Facts and Figures

Since 1928, I.F.U.W. awards of 78 fellowships and 18 grants have been made to outstanding scholars of 24 countries and of at least 27 nationalities.

TABLE 1

Country sponsoring the Recipient	Fellowship	Grant	Total
Argentine	1	1	2
Australia	9	0	9
Austria	4	1	5
Belgium	1	2	3
Bulgaria	0	1	1
Canada	3	1	4
Denmark	5	0	5
Finland	0	1	1
France	2	0	2
Germany	3	1	4
Great Britain	13	2	15
Hungary	1	1	2
India	5	0	5
Italy	1	2	3
Netherlands	9	2	11
Norway	5	0	5
Palestine	3	0	3
Poland	3	0	3
South Africa	1	1	2
Sweden	3	1	4
Switzerland	4	1	5
U.S.A.	2	0	2
	78	18	96

In addition to the awards tabulated above, scholars from the following countries were offered awards which they could not take up for various reasons: Great Britain 3, Norway 1, India 1.

The countries to which these I.F.U.W. scholars have gone number more than twenty-four. Some 44 have pursued their researches in Great Britain, 19 in the United States, 7 in France, 7 in Italy and 4 in Holland, 9 in Scandinavian countries, 3 went to Austria, 3 to Ireland, two to Germany, to India, to Canada, and one to each of the following: Persia, Palestine, Egypt, Arabia, Yugoslavia, Spain, Honolulu, Brazil, British Guiana, Australia and New Guinea. Depending upon the scope and nature of their subjects, our scholars have concentrated in one place for the full period of their fellowship or have divided their time between two or more countries. The increasing desire to take advantage of the growing facilities for research in American universities is obvious. From 1928 to 1939 only 3 out of 19 went to the U.S.A., but 11 of the 41 scholars selected in 1947-53 have chosen to hold their awards in the U.S.A.

It is interesting to note the wide range of subjects for which our research fellowships and grants have been made. In Table 2 a rough grouping is given.

TABLE 2

	Fellowships	Grants	Total
Literature, Philosophy ...	11	2	13
Linguistics, Philology ...	4	1	5
History, Economics, Sociology	6	2	8
Anthropology, Folklore ...	3	4	7
Archaeology	5	2	7
Art	5	2	7
Musicology	1	0	1
Mathematics	3	0	3
Agriculture	1	0	1
Biology, Entomology ...	16	3	19
Bacteriology, Medicine, Dentistry, Nutrition ...	5	1	6
Chemistry, Biochemistry ...	8	1	9
Crystallography	3	0	3
Geology, Mineralogy ...	4	0	4
Physics, Astrophysics ...	3	0	3
	78	18	96

Faith in a threefold service

Many thousands of university women in many countries have worked and given in order to provide these fellowships and grants. The I.F.U.W. Committee for the Award of International Fellowships recognises this great work and sees the need for further effort. It hopes that the first I.F.U.W. Fellowship may be henceforth known as the Ida Smedley MacLean International Fellowship in recognition of her pioneer efforts and far vision.

If the facts and statistics given in this paper are read with imagination and sympathy, they will speak a message of intellectual aspiration, of hard work and patient toil, of high hope and proud success; of new vistas, fresh experiences, increased usefulness, genuine contributions to scholarship; of greater international understanding, and lasting friendships. These influences are needed in the world that is to be shaped from the present confusion. Ethics and economics alike cry aloud for practical internationalism and every influence that tends in this direction, that is educating individuals and communities to think and work, to sacrifice and co-operate towards this end, is of immense importance.

These scholars are ambassadors of cultural understanding between their countries and the country to which their research takes them. Integrity in the pursuit and interpretation of knowledge is their primary characteristic. It is our hope and belief that a scholar's high faith in honesty will influence all her associates. In so far as our scholars are an influence to this end, the I.F.U.W., through these research fellowships, is achieving a threefold service by its work for scholars, for scholarship, and for constructive internationalism.

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INTERNATIONAL FEDERATION OF UNIVERSITY WOMEN AND SCHOLARLY RESEARCH

(No. 3, 1956)

by

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Past President I.F.U.W.
and Convener of the Committee for the Award of International Fellowship.

INTRODUCTION

In "The International Federation of University Women and Scholarly Research" (I.F.U.W. publication 1950 and No. 2, 1953) I outlined the early efforts of the I.F.U.W. to encourage advanced scholarly work by women whose training and temperament fitted them for such activity. It is an international record which must not be allowed to drop out of sight and mind. I am therefore including one paragraph from the former publication in this report.

In 1923, the Council adopted a resolution brought forward by Dr. Smedley Maclean proposing a scheme to raise a fund for providing international fellowships and prizes. In 1924 this fund was established, the first gift being of great significance and unusual interest. It was reported to the Council by Dr. Gleditsch that in 1913 a group of elderly Norwegian men met to celebrate the 50th anniversary of their graduation and decided to collect some money for a research fellowship to be given to a woman—two thousand krone had been collected when the war came, and their plan was abandoned; but in 1924 the surviving members of the group decided to hand over the whole sum to the International Fellowships Fund of the I.F.U.W. This gracious act was an inspiration, and by 1926 contributions had been made by eleven National Federations. The fund slowly accumulated until in 1928 the first international award of a Fellowship, valued at £250, could be made. The final £1,000 of the endowment fund was placed in the hands of Professor Winifred Cullis, the President of the Federation, at the Prague Council meeting of 1930 by President Masaryk as his personal contribution to an international project the value of which he had at once appreciated.

Four years later came the first of the wonderful series of international fellowships endowed by the American Association of University Women; and from time to time many other national associations have contributed a fellowship or a substantial grant; this year the Canadian Federation of University Women has given a fellowship for annual award by the I.F.U.W. Committee. All this is in addition to the large number of fellowships and bursaries which different countries have raised and administered within their own association for their own scholars or for scholars of other countries.

From 1928 to 1956 the I.F.U.W. Committee for the Award of International Fellowships has made ninety-eight awards of fellowships and twenty-six grants. These have gone to candidates of at least twenty-eight nationalities proposed by twenty-four national associations. A quite remarkable balance has been the result of the policy of selecting the most competent scholar, irrespective of her field. Of the 124 awards made in these twenty-nine years, sixty-two have gone to assist research in art, music, literature, archæology and the social sciences generally; and sixty-two have gone to scholars in the fields of mathematics, physical sciences, biological and medical sciences.

REPORT ON QUESTIONNAIRES FROM I.F.U.W. FELLOWSHIP AND GRANT HOLDERS

Two years ago the A.A.U.W. prepared a questionnaire for their fellowship holders, and in slightly amended form it was sent also to those scholars whose award had been made by the I.F.U.W. Committee for the Award of International Fellowships from 1928-54.

Forty-five questionnaires have been returned to the I.F.U.W. office covering the period 1930 to 1954-55. Of these forty held fellowships and five held grants. As ninety-two fellowships had been held between 1928 and 1955, it is disappointing to find that fifty-two recipients have not returned the questionnaire.

It is interesting to note that all but one of the forty-five who have reported are active in education or research, whether they are single or married. Fifty-two per cent. are married. Thirty-eight have recorded publications since the tenure of the Fellowship; of the others, five have papers in preparation.

In summarising the most interesting facts about these scholars, I have grouped them under the respective awards since it is always of particular interest to those who contributed to the endowment of a fellowship to know what the investment has produced. The present position, the date and place where the fellowship was held and the publications are given for each.

INTERNATIONAL FELLOWSHIP (IDA SMEDLEY MACLEAN)

1. Professor of Plant Physiology and Biochemistry in Pretoria. To California 1930-31. Twenty-two papers and articles. Active in S.A.A.U.W.
2. Petrologist and research director, National University, Australia. To England 1933-34. Thirty papers. D.Sc. 1950.
3. Research position in Medical Biochemistry at Cambridge, England. Polish by birth. To Cambridge 1938-39. Forty papers 1936-53.
4. Lecturer in medieval economic history, Liverpool. German by birth. To England 1939-40. Four papers, 1947-55, and one in preparation on "Walter of Henley."
5. Lecturer in organic chemistry, Melbourne, Australia. To Scotland 1945-46. Twelve papers 1941-54, in particular on the synthesis of Tumour Inhibiting Compounds.
6. Lecturer and director of research in Marine Biological Station, Portobello, U.S.A. A New Zealander. To England 1947-48. Thirteen papers published or in preparation. Special subject is the nervous system of sea anemones.
7. Professor of English Literature, Toronto, Canada. To England 1948-49. Guggenheim Fellowship 1953. Three books and several papers on S. T. Coleridge, his Philosophical Lectures, Notebooks, etc.
8. Fellow of an Oxford College after one year as Professor of English at a university in Spain to further knowledge of Spanish required for continuation of social anthropological research in the Guianas. To British Guiana and U.S.A. 1951-52. Three papers 1952, 1953.

9. Partner and research director in a firebrick industry in Scotland. To M.I.T., U.S.A., 1951-52. Eight papers on ceramic problems and slag metallurgy.
10. Lecturer in Nagpur College of Science and a research director in Fossil Botany. To England 1953-54. Vice-President of her branch of Federation of University Women in India. Three scientific papers, also articles and a book of poems in Marathi.
11. Assistant in English Philology, University of Helsinki. A Finnish scholar of Middle English. To England 1954-55. One article and two books on "Sir Gawain" (1951) and "St. Catherine of Alexandria" (in preparation).
12. Senior Lecturer in University of Queensland, Australia, on extended leave for research in parasitology in School of Tropical Medicine in London 1954-55. Ten papers and three in preparation.

CRUSADE (A.A.U.W.) FELLOWSHIP

(first awarded in 1934)

1. Associate Professor of English Vassar College, U.S.A. German citizen. To England 1936-37 for 7th and 8th century Latin and Old English. Two books, four papers 1919-49. Three books awaiting publication: Aldhelm and his Enigmas, Enigmas of Huetberht and Tatneine, New Edition of Old English Riddles.
2. Associate Professor of Biochemistry. Chicago, U.S.A. Norwegian by birth. To U.S.A. 1939-40. Three papers alone, forty-four in collaboration 1936-54 on carbohydrate metabolism.
3. Housewife in Australia after fellowship year in England 1950-51 investigating luminescence of marine organisms—problem continued by Oxford professor. Three papers prior to fellowship.

MARY E. WOOLLEY (A.A.U.W.) FELLOWSHIP

(first awarded 1940)

1. Lecturer in Russian Language and Literature, Liverpool, England. Russian by birth. In England 1940-41. Kierkegaard's philosophy. No publications.
2. Housewife after being a lecturer in English Literature in Bombay. To U.S.A. 1945-46, after three years in Cambridge, B.A., M.A., M.Litt. This Indian scholar has published two articles on William Blake and a book (in collaboration), *Songs of Zarathustra*; a book on Blake's Pictorial Sources is in progress.
3. A musicologist from Germany, now U.S.A. citizen. To England 1947-48. Ten articles 1947-55. A book, *Heavenly Music and the Dance of Death*, in preparation and a book of music incunabula in press (Oxford).
4. Lecturer in University of Jerusalem in Zoology and Genetics. German by birth. To U.S.A. 1950-51. Ten papers 1951-55.
5. Housewife and Demonstrator in Biology in the University of New Brunswick, Canada. To England 1951-52. Working in animal cytology. Three papers 1951-52, one in preparation.

3. (Also a *Winifred Cullis Grant*). Trustee and Chief Curator Genoa Natural History Museum. From Italy to London and Paris 1954-55. One hundred and seventeen publications and museum notes chiefly on Hymenoptera and fishes.

4. (Also a *Winifred Cullis Grant*). Research scholar in Paris; from Latvia to Germany to Switzerland and with Award and Grant to Paris (1954-55) continuing work on medieval French sculpture and its intellectual background, monograph in preparation. Book published in Basel 1951, *The Application of Quadrature and Triangulation in the Construction of Gothic Cathedrals*. Seeking museum or teaching position.

I.F.U.W. SPECIAL GRANT

1. Assistant Curator of Ethnological Department, Royal Museum, Brussels, and lecturer on prehistoric art. Award made 1940, used after the war for studies in Malta, Italy, France, Switzerland, Netherlands. Three books, two papers and eighty "comptes-rendus".

CONCLUSION

Although not half our scholars have returned the questionnaire, I am confident that the I.F.U.W. members in every country will draw the conclusion from the reports summarised in this survey that our investment of thought, time and money in research fellowships has been fully justified. The productive scholarship here recorded is considerable and the influence of these scholars upon their associates, their students and their communities is beyond estimation.

Our purpose is three-fold: (1) to aid scholarly women in the pursuit of knowledge; (2) to augment the sum total of knowledge; (3) to create greater international understanding as our scholars take something of their own national ideals and culture to another country, and on return bring back the fertilising pollen of another culture to their own communities.

Integrity in the pursuit and interpretation of knowledge is the primary characteristic of a scholar. In so far as their high faith in honesty influences their associates wherever they may be, our scholars are helping the I.F.U.W. to achieve one of its greatest aims—the promotion of understanding and trust founded on knowledge and respect; this alone can lead to constructive internationalism.

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THE INTERNATIONAL FEDERATION OF UNIVERSITY WOMEN AND SCHOLARLY RESEARCH

(No. 4 — 1965)

by

A. VIBERT DOUGLAS, M.B.E., Ph.D., LL.D.

(President IFUW 1947-50 and Convener of Committee for the Award of International Fellowships)

Looking into the Past

The first summary report of the work of the Committee for the Award of International Fellowships was prepared for the IFUW Conference in Stockholm in August 1939. It was an account of slender beginnings but already distinguished results of researches by the recipients of our Fellowships. Further reports were published in 1956 for the Paris Conference. This fourth report of the numbered series brings the record forward another nine years.

Early efforts and beginnings must not be allowed to pass into oblivion. In 1923 the Council adopted a resolution sponsored by a distinguished lecturer in biochemistry at the University of London, Dr Ida Smedley Maclean, that a fund be raised to provide international research fellowships and prizes. In 1924 this fund was established, the first gift being of great significance and unusual interest. Dr Gleditsch, the third President IFUW, reported to the Council that in 1913 a group of Norwegian men met to celebrate the 50th anniversary of their graduation and decided to collect money for a research fellowship to be given to a woman—two thousand krone had been collected when the war came, and their plan was abandoned; but in 1924 the surviving members of the group decided to present the whole sum to the International Fellowship Fund of the IFUW. This gracious act was an inspiration and within two years contributions had been made by eleven national associations. The fund slowly grew until in 1928 the first international award of the value of £250 could be made. To help complete the endowment the sum of £1,000 was placed in the hands of Professor Winifred Cullis, fourth President of the Federation, at the Prague Council meeting in 1930 by President Masaryk as his personal contribution to an international project the value of which he fully appreciated.

Four years later, in 1934, the American Association of University Women presented for award by the IFUW the first of a splendid series of research fellowships; and in 1956 the Canadian Federation established a research fellowship for award annually by the IFUW. From time to time many other national associations have contributed a single fellowship or a

substantial grant to bring a foreign scholar to their own countries. All this is distinct from the large numbers of fellowships and bursaries which countries raise and administer within their own associations for their own scholars or for scholars from other countries.

In the paragraphs which follow a few only of the awards will be mentioned. Reference should be made to Paper No. 3 of this series for an account of the results of a questionnaire to past Fellows showing the rich harvest of scholarly work towards the achievement of which these Fellowships played an initial part.

IFUW—Ida Smedley Maclean Fellowship

First awarded in 1928. Twice divided between two scholars. Number of recipients to date: 39.

By unanimous recommendation of the Committee, and with Council approval, the name of Ida Smedley Maclean (1877-1944) was identified with this first fellowship about ten years ago.

The first recipient was a Swiss biologist who pursued genetics research in Berlin; three years later, with a Carnegie grant, she worked in Baltimore; in 1940 she became Chief Assistant in histology and embryology at the Medical School of Geneva and has many published papers. In the last eight years the award has gone successively to New Zealand, USA, Philippines, Great Britain, Australia, Sweden and Canada and Switzerland for such diverse studies as history, international law, botany, histology, oceanography and Mexican anthropology.

Seventeen of these fellows have worked in the physical or natural sciences or allied subjects in the medical field. Twenty-two have pursued research in art or archaeology, literature, economic history or other subjects in the wide group of social studies. They represent nineteen nationalities and the places to which they travelled are dotted over five continents.

AAUW—Crusade Fellowship

First awarded: 1934. Number of recipients to date: 10

The first AAUW International Fellowship bridged a gap between the time when very little research assistance was available to women and the endowment by regional groups within the AAUW of one after another of the named fellowships.

First recipient was a German bacteriologist who went to Great Britain. A scholar from the Netherlands studied Persian language and literature in Iran; and to Sweden went an Italian physiologist to study nerve tissue; to USA went an Indian chemist; and to France a German philologist. The last recipient (1950) was a marine biologist from Australia who did her research in Oxford.

AAUW—Mary E. Woolley Fellowship

First awarded: 1940. Number of recipients to date: 22

Mary E. Woolley (1863-1947) was one of the first two women to receive the B.A. degree from Brown University (1894). She was President of Mount Holyoke College for 36 years; and President of AAUW 1927-33. To this distinguished educator with international vision the four North Atlantic state divisions of AAUW paid tribute by endowing this Fellowship.

Awarded first to a Russian refugee to study Social Philosophy in England, and subsequently to scholars from 14 countries who have followed a wide range of interests, among them being history in Indo-China, neo Syriac dialects in Turkey and Persia, pre-Celtic periods in Europe, ancient music in Paris, Etruscan sepulchral art, crystal structure, botony and zoology in the USA and Canada. In 1963 a Belgian oceanographer carried through a research in Marseilles, in 1964 an Argentine physicist went to Great Britain and in 1965 a Brazilian economist will go to Paris.

AAUW—Ohio State Fellowship

First awarded: 1942. Number of recipients to date: 21

Endowed through the efforts of the state division of Ohio. The first award was to an Indian scholar in the field of Sanskrit Mathematics to examine copies of the work of Bramagupta (A.D. 598) to be found only in London and Oxford libraries. The 1963 and 1964 recipients were also Indians, a physicist who came to the University of Illinois, USA, and a student of British Indian history in Oxford. In the intervening years a Swedish philosopher, Danish philologist, French chemist, Argentine biochemist, Dutch crystallographer, Australian anthropologist, New Zealand botanist, French sociologist (to name but a few) profited by this Fellowship. The most recent recipient is a Czech scholar resident in Great Britain who will go to Cambodia for anthropological studies.

AAUW—Helen Marr Kirby Fellowship

First awarded: 1944. Number of recipients to date: 21

Helen Marr Kirby (1837-1921) of Alabama was a pioneer in higher education in America. She received a B.A. in 1855 from Wesleyan Female College in Georgia and became "Lady Assistant" in the University of Texas in 1884 rising slowly to full recognition as a Faculty member and giving in all over 50 years to the tasks of education. The Texas state in this Fellowship honoured a strong and gentle woman.

The first award was to a Palestinian entomologist for research in London on disease-carrying insects. Recent recipients were to an Austrian meteorologist, an Israeli biologist and a Netherlands student of French literature. The 1963 award went to a Canadian classicist for research in Cambridge University; in 1964 it was divided between a New Zealand zoologist and an Austrian

studying West African native architecture, both these completing researches begun previously with the aid of our Fellowships. The 1965 winner is an Australian who will go to Oxford to pursue further work on recent Indian history.

AAUW—Virginia C. Gildersleeve Fellowship

First awarded: 1946. Number of recipients to date: 18

Dean Virginia C. Gildersleeve (1877-) of Barnard College, Columbia University, New York, was one of the founders of IFUW and its second and sixth President. In honour of this charming woman of erudition, practical wisdom and international stature, the New York City Branch endowed this Fellowship when she was appointed a delegate to the UN Charter Conference.

An English botanist who studied bog flora in Minnesota was the first recipient. Other awards were to a Turkish colloidal chemist, a Dane to pursue Etruscan studies, a British archaeologist for work in Greece, a Swiss philosopher interested in French thought and an Italian for endocrinological studies in Boston. The award in 1963 was to a British scholar of Greek background who worked on Byzantine history in Italy, in 1964 to a student of French literature for a year at the University of California, and in 1965 to an Argentinian chemist for petrolium studies in Italy.

AAUW—Alice Hamilton Fellowship

First awarded: 1950. Number of recipients to date: 14

Dr Alice Hamilton (1869-) obtained the M.D. at the University of Michigan in 1893 and became a dynamic spearhead in the fight for public health and Industrial Disease prevention. She was the first occupant of the Chair of Industrial Medicine at Harvard in 1919. The Connecticut-Rhode Island Fellowship honours this pioneer humane physician.

It has become a custom in the Awards Committee to assign this Fellowship to one of the successful candidates in a scientific field.

The first holder was a Norwegian who carried on research in crystallography in Cambridge University. The last two recipients were a Turkish astronomer who received the award to enable her to work in Meudon, France, and a Netherlands microbiologist who has gone to California. Other awards have gone for research in tropical parasites, nutrition, neurophysiology, and cardiology. Scholars from ten countries, including Hong Kong, have enjoyed the benefits of this fellowship. The latest award is to enable a Greek dermatologist to pursue further research in Paris.

CFUW—A. Vibert Douglas Fellowship

First awarded: 1958. Number of recipients to date: 8

A. Vibert Douglas (1894-) retired Professor of Astronomy has completed 41 years of academic work, first at Mc Gill University, Montreal,

then at Queen's University in Kingston, Canada; she has been active in international educational work, in UNESCO and in IFUW of which she was the eighth President, and for 18 years a member of the Fellowship Award Committee. The Canadian Federation donated this Fellowship.

The first scholar was a distinguished Indiologist from the Netherlands whose studies of art and archaelogy in India brought her a high academic appointment in England and later a professorship in her own country. Other recipients have been a Swedish pathologist for work in USA, an Austrian botanist who went to Germany, a Brazilian chemist to France, and a Canadian educator to England, whose study of methods of teaching handicapped children should bear fruit in future, and the 1965 award will permit an Italian sociologist to compare the evolution of Italian unions with those of Britain, in the latter country.

AAUW—Marion Reilly

First Awarded: 1941. Number of recipients: 9

Marion Reilly (1879-1928) Dean of Bryn Mawr College 1909-16, the AAUW authority on academic standards especially European degrees and those from other continents, a scholarly woman with wide vision, honoured by the Philadelphia Branch who established this International Award. It has been used to assist scholars to carry through to publication work already in progress or for short term projects where an entire year was not possible or necessary.

Given first to an Argentine dentist for studies in child dental care in Brazil; then to a Swede for work on religious art in Denmark; to a Latvian refugee in Switzerland for architectural studies of the Gothic in Paris; to a Dutch archaeologist for work in USA leading to a Princeton Institute appointment to excavate in Turkey and subsequently a professorial position at Bryn Mawr. These examples demonstrate the far-reaching value of this award which was available only between the years 1941-53.

IFUW—Winifred Cullis Grants

First awarded: 1954. Number of recipients to date: 23

As more nations with recently established national associations of university women became members of IFUW the Fellowships Award Committee was faced each year with applications for assistance to carry out advanced study in methods and techniques not available in their own universities. Obviously these were women of purpose and promise but not eligible for research fellowships. The Committee therefore asked the Council to set aside IFUW funds to be used as grants at the discretion of the Committee; and that these grants bear the name of Winifred Cullis. Thus the fund was established in 1953.

Dr Winifred Cullis, C.B.E. (1875-1956), Professor of Physiology at London School of Medicine for Women, was one of the founders of IFUW in 1919, and its fourth president; a buoyant, vigorous teacher and lecturer, an

enthusiastic advocate of science and the arts, a truly outstanding citizen and servant of her government and of the IFUW.

Among the 23 recipients were an Australian of Chinese descent, assisted in California with her study of viruses; a Greek lawyer observed methods of criminal law relating to juvenile delinquency in Rome; of three microbiologists, two from Argentine and one from Finland, one went to New York, one to Paris and one to the Lister Institute in London; an Austrian undertook research on desert water in Iran; a Japanese astronomer continued work in Great Britain; a Brazilian chemist in Austria, a Danish Egyptologist in several European museums and in 1965 a Dutch Anthropologist will go to Surinam and a scholar from Israel will prepare a second book on the problem of consciousness in *The Writings of Henry James*.

Thus both advanced training programmes and short-period researches are made possible from this invaluable fund. The fund is not endowed and annual contributions from national associations are needed to maintain it.

Looking into the Future

We can take pride in the fact that 153 awards of fellowships, 10 grants prior to 1940 and 32 since that date, have been made to women of at least 33 nationalities providing them with encouragement and invaluable experience, and resulting in much scholarly work. But we are aware that we shall not move forward by only looking backward.

With the modern age calling for more professional training and higher skills, more women are entering universities and attaining post graduate status. We may expect an increase in the numbers of applicants for both fellowships and grants. Will funds be forthcoming to meet the growing need?

The many newly self-governing nations of Africa are showing a zest for education which will in very few years bring more of their young universities to the level of research centres. Applications for grants for advanced training will soon be coming to IFUW as the university women of these countries establish national associations and look to us for aid. Eventually research fellowships will also be sought. IFUW must look ahead and think not in 3-year spans but in decades.

We anticipate that the policy of selecting the best applicants irrespective of subject, will produce, as in the past, that happy balance between the arts, humanities, social studies and the mathematical, physical and biological sciences.

We believe that our scholars with their ideals of integrity and high faith in honesty help to increase international understanding as they go and come from country to country. In so doing they are helping the IFUW to achieve one of its major aims—to further the spirit of mutual helpfulness, understanding and trust between the nations of the world.

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International Fellowships

Notes and Comments on the Granting of Fellowships
By the I. F. U. W.

When so much international work is at a standstill, and so much that we had thought was built upon firm international foundations appears tragically overthrown, it is encouraging to pause for a few moments to consider a part of the work of the International Federation of University Women that has neither ceased nor slackened, though difficulties crowd its path in these days of world war.

The International Fellowships Committee of the I. F. U. W. is composed of five members from European nations and five form the Americas. In peace time the meeting, for the annual awarding of the Fellowships and grants at the disposal of the Committee, was to take place in Europe and in America alternate years. While Europe is torn by war and dominated so largely by a country whose governmental policy is openly hostile to any international organization of university women, it is not practically possible to obtain even the written collaboration of all the five European members, and utterly impossible to get them assembled together in conference. So for these war years the meetings are being held in the U. S. A. where the four American representatives and the representative from Canada can meet to discuss the relative merits of the various applicants, reading and considering the decisions and comments of any of the European members who have been able to send their communications to the executive secretary.

This year we had before us fifteen applications transmitted from eleven national associations. Three associations sponsored German or Austrian refugee scholars. One is an economist, a Ph.D., of Heidelberg, who has found haven in Sweden after three years in Madrid and two in Prague, having left Germany in 1933. She desires to study regulated state economy in the U. S. A. and in Mexico. Another is a biologist holding a doctorate of the University of Berlin and for the last three years a research worker in the Zurich Zoological Institute. Her name was submitted by the Swiss Association, together with that of an Austrian zoologist of distinction, who obtained her Ph.D. in Vienna, won Fellowships from Vienna, from Germany, U.S.A., and Girton College, Cambridge, in the 1920's, and left Central Europe in 1938. In the University circles in countries other than their own, these scholarly women, no longer wanted in their native lands, are being helped and encouraged at this time when encouragement and help are so sorely needed.

Nine of the applicants planned to carry on work in the

U.S.A.: an Irish psychologist, a Swedish statistician and sociologist, a Brazilian biologist, an Egyptologist from Palestine, a South African scholar working on the life of Browning, an Indian student of Sanskrit, and the three Central Europeans mentioned above. An American botanist wanted to go to Honolulu to study Araucaria; an Hungarian doctor hoped to go to a Medical centre in Switzerland to investigate immunization of infants against measles; a graduate of Smith, Wellesley and Bryn Mawr planned to study the cultural and political influence of Sarmiento in Brazil, Argentine and Chile; an Argentine dentist wished to pursue dental and chemical research in Brazil.

Two fellowships of £250 each, and one grant of $200 were available this year. The grant was given to Dr. Alina de La-Porte for dental research expenses in Buenos Aires, this being the first I. F. U. W. award to an applicant from Latin America. The fellowships were awarded to Dr. Sophie Piccard, of Lausanne, Switzerland, an able mathematician with an excellent record of independent work, and to Dr. Bina Ghosh, graduate of Hindu University, Benares, and of Oxford, where she completed a critical edition of the Khandakhadyaka of Brahmagupta. This is a Sanskrit work dated 598 A.D., dealing with geometry, astronomical formulae and the first known application of the principle of interpolation in methematics. Dr. Ghosh is highly recommended by two Sanskrit scholars, Professor E. K. Johnston and Professor F. W. Thomas, both of Oxford, where she worked for three years obtaining the D.Phil. in 1940. She will proceed to Harvard where there is an excellent Sanskrit department and then complete her research in India where her book will be published.

This is the second Indian woman to receive an I. F. U. W. fellowship. In 1938, Dr. Kamela Bhagvat was the recipient and obtained her Ph.D. in Biochemistry at Cambridge University, returning to India to a teaching position in the autumn of 1939. In the same year a fellowship was awarded to Dr. Cecilia Lutwak-Mann, a medical graduate of Lwow, Poland. The Canadian member of the Committee saw Dr. Mann at work in the Cambridge laboratories in July, 1939. She was then engaged on a study of the chemistry of heart muscles and had been awarded a Newnham College fellowship for the ensuing year. A recent letter from her reports the isolation of a hitherto unrecognized enzime. She is very happy to be privileged to continue her researches in Cambridge and is obtaining results of undoubted merit.

In the tables that follow, an attempt is made to summarize the interesting facts about the recipients of awards since the first international fellowship was given in 1928. The distribution of nationalities, of subjects, and of countries to which the scholars proceeded offers food for much interesting contemplation. These tables constitute a challenge to the university women of certain countries.

If studied with sympathetic understanding and a little imagination these facts will not remain merely intensely interesting statistics. They will speak their message of intellectual aspiration, of hard work and patient toil, of high hopes and proud success, of new vistas, fresh experiences, increased usefulness, contributions to scholarship, greater international understanding, and lasting friendships. These influences are needed in the world that is to be shaped from the present junk heap of nations and peoples—some confused and bewildered, some trodden under cruel feet, some ignorant of what is actually happening in the world, some still obsessed with blood-lust upon whom disillusionment and suffering will fall, some straining with superhuman endurance to fight on and on for the ideals they cherish. Ethics and economics alike cry aloud for a practical internationalism and every influence that tends in this direction, that is educating individuals and communities to think and work, to sacrifice and co-operate towards this end, is of immense importance. In their work on behalf of travelling fellowships our International Federation and our national associations are making a lasting contribution to the furtherance of goodwill, trust and understanding between nations.

A. VIBERT DOUGLAS,
Queen's University, Kingston, Ont.

TABLE I

International Fellowships (Senior and Junior)

14 Fellowships, (1928—1941).
17 awards due to division of Fellowship between two applicants in 1934 and 1939 and to resignation of winner in 1940 due to war duties in Great Britain.

Country of Recipients		Countries Where Fellowship Held		Subjects	
Great Britain	4	Great Britain	5	Archaeology	2
Netherlands	3	Ireland	3	Economic History	2
Switzerland	3	U. S. A.	3	Biology	2
Australia	1	Germany	2	Geology	2
Austria	1	Norway	2	Art	2
France	1	Sweden	2	Celtic Literature	1
Germany	1	Arabia	1	History	1
India	1	Austria	1	Indian Culture	1
Norway	1	Denmark	1	Botany	1
Poland	1	Italy	1	Biochemistry	1
		India	1	Radiology	1
		Netherlands	1	Mathematics	1
		Switzerland	1	Sanskril Mathematics	1

TABLE II

Crusade Fellowship and Mary E. Woolley Fellowship. 7 Fellowships (1934—41). 7 awards.

Country of Recipients		Countries Where Fellowship Held		Subject	
Germany	2	Great Britain	5	Philology	2
Hungary	1	France	2	Chemistry	2
India	1	U. S. A.	1	Bacteriology	1
Norway	1			Botany	1
Russia	1			Social Philosophy	1
U. S. A.	1				

TABLE III

Minor Awards: 11 grants of from 150 pounds to 25 pounds value. (1935—1941.)

Country of Recipient		Countries where Grant Held		Subject	
Belgium	2	Great Britain	3	Chemistry	2
Germany	2	Baltic Countries	1	Ethnography	2
Argentina	1	Brazil	1	Archaeology	1
Austria	1	France	1	Dentistry	1
Bulgaria	1	Germany	1	Dramatic Art	1
Finland	1	Honolulu	1	Entomology	1
Great Britain	1	Italy	1	Folklore	1
Holland	1	South-eastern Europe	1	Philology	1
Hungary	1	Spain	1	Social Science	1
		Yugo-Slavia	1		

TABLE IV

Summary: 35 awards (1928—1941). Scholars in exile have been sponsored by the National Federations or Associations of the countries in which they found refuge.

Country of Recipient		General Classification by subjects	
Germany	5	Literature, history, folklore and art	6
Great Britain	5	Archaeology, ethnography	5
Netherlands	4	Philology, linguistics	3
Switzerland	3	Philosophy, economics, social sciences	4
Austria	2	Biology, bacteriology, entomology, pathology, radiology, dentistry	9
Belgium	2	Chemistry	4
Hungary	2	Geology, petrology	2
India	2	Mathematics, (ancient and modern)	2
Norway	2		
Argentina	1		
Australia	1		
Bulgaria	1		
Finland	1		
France	1		
Poland	1		
Russia	1		
U. S. A.	1		

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Island Galaxies.

By A. Vibert Douglas, Ph.D.
McGill University, Montreal.

THE knowledge that the heavens contain bodies that are neither planets nor stars is age-old, for the keen eyes of the star-gazers of civilizations long since gone did not fail to detect such objects as the nebulosity in the constellation of Orion and the small, hazy patch in Andromeda. But the significance of these objects remained a mystery for many centuries.

With the invention of the refracting telescope by Galileo about 1600, many of the apparently nebulous regions in the Milky Way were found to be resolvable into separate stars. These are so closely strewn in the sky that to the unaided eye their light is completely merged and blended. Towards the end of the seventeenth century, the second great type of telescope was devised by Sir Isaac Newton, namely, the reflecting telescope in which the starlight is brought to a focus not by a lens but by a mirror. About one hundred and fifty years later, when the small pioneer telescopes of Galileo and Newton had given place to large and powerful instruments, Lord Rosse discovered that a certain nebulous region in the constellation Canes Venatici when viewed through his great telescope was a cluster of many stars, and not merely a random, haphazard cluster, but distinctly grouped in the configuration of a spiral (Fig. 5). Thereafter the search for and discovery of other spiral nebulae became one of the most fruitful tasks of the astronomer. From that time to the present, as a result of ever-increasingly powerful instruments together with the introduction of photographic methods, many hundreds of spiral nebulae have been found.

[*Photo, Mt. Wilson Obsy.*

FIG. 1.
ISLAND GALAXY (M. 64).
An early type spiral nebula in the constellation Coma Berenices.

Speculation was at once begun. Could it be that all the nebulae were in reality close assemblages of stars requiring only yet more powerful telescopes to show each star separately?

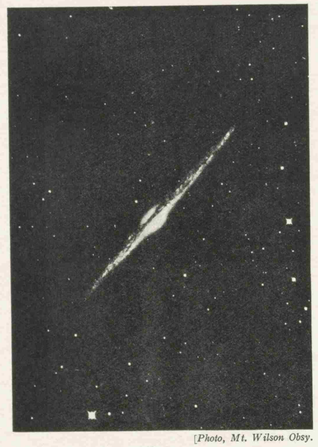
Sir Wm. Huggins gave the decisive negative answer to this question—some of the nebulae are great clusters of stars, but there are others truly named nebulae, for they are masses of glowing gas having the type of spectrum typical of gas so hot that the atoms are radiating their characteristic quanta of energy.

Such is the nature of the Great Nebula in Orion, and of many other nebulae where vast regions of space are sparsely filled with gaseous matter. Where these gases are sufficiently hot, they radiate the distinctive wave-lengths of light associated with the atoms and molecules of which they are composed. Thus the spectroscopist identifies in these nebular spectra the unmistakable radiations of hydrogen and helium, often also nitrogen and carbon, and in addition to these he finds intense radiations which, until recently, were attributed to an unknown substance called nebulium. The mystery is now solved by Dr. Bowen, California, who attributes these radiations to oxygen and nitrogen atoms, radiating in an unusual manner as a result of their ionized condition and the low density of the nebulae.

The gaseous nebulae are not all sufficiently hot to radiate; some of them glow on, because of the proximity of very bright hot stars; others are so cool that they absorb all the starlight that falls on them, thus forming great black patches

in the sky. A famous dark nebula in the region of the Southern Cross is known as the "coalsack." A great American observer, the late Professor Barnard, has made a systematic study of these opaque clouds, of which he listed over one hundred and eighty, varying from very small patches with sharp outlines to the long irregular "dark lanes" so striking a feature of the constellation of Ophiuchus.

We know, then, that of the celestial objects called nebulae, some are vast clouds of gas occupying regions of space compared with which our solar system is absolutely insignificant, while other nebulae, in particular the spiral nebulae, are clusters of stars.



[*Photo, Mt. Wilson Obsy.*

FIG. 2.
ISLAND GALAXY (H.V. 24).
Edge-on view of a spiral nebula in the constellation Coma Berenices. Five hours exposure. Foreground stars are in our Galaxy and the brighter ones are distorted by over-exposure.

For a long time no one had any conception of the immensity of spiral nebulae. They were thought of as comparatively small aggregations of stars within the great assemblage of stars surrounding our sun in all directions. The authors of the Planetesimal Theory drew an analogy between the arms of a spiral nebula and the arms of gaseous matter which they assumed to have been drawn out from the surface layers of our sun by the tidal forces produced by a passing star, these disrupted arms giving rise to the several condensations of matter which eventually became the planets of the solar system. Gradually, however, it became apparent that a spiral nebula was not to be compared with the solar system, but rather with the whole galaxy of stars—our sun and the thousand million other suns which stud the heavens all around us.

There are known to be many thousand spiral nebulae, and if each be comparable in size to our whole stellar galaxy, it is obvious that they are not within it. They are, in fact, *island galaxies*. The term is here used to denote exactly the same thing as the term Island Universes which has become so common an expression in American astronomical writing. Since "Universe" is defined as "all that exists, the creation and the Creator," its use in the plural seems unfortunate, especially as the word Galaxy is quite adequate. Dignifying our stellar system by the name *the* Galaxy—not merely because it is the system to which our sun belongs, but for the more logical reason that as yet no other aggregation of stars is known to be quite as large—it then becomes natural to divide all nebulae into two main classes, termed respectively the *galactic* and the *extra-galactic* nebulae.

Our galaxy is a gigantic aggregation of stars and gaseous nebulae. It comprises all the stars visible to the naked eye and the many thousands more revealed by the telescope when used visually. These numbers are multiplied many-fold by the use of photography when stars so faint or remote as to be invisible leave the impress of their images upon the sensitive plate after many hours of exposure. The study of these photographs, counting the numbers of the stars of different magnitude or brightness, and comparing the numbers in different parts of the sky, has shown that it is possible to make an estimate of their number and a representation of their distribution in space.

Even with the unaided eye it is evident that the distribution of stars is not spherically symmetrical. All along a great circle in the heavens the stars are more numerous than elsewhere, and this encircling band is called the Milky Way. The photographic plates reveal the same concentration, and so the Milky Way is called the galactic plane, while the directions at right angles to this plane, where the stars are less numerous and on the average less distant, are termed the galactic poles. Our sun happens to be situated not far from the centre of this great lens-shaped cluster of stars. The dimensions of the galaxy are so vast as to be best appreciated when expressed in light-years, the unit so frequently employed by astronomers, equivalent to nearly six billion miles. Our galaxy is approximately 100,000 light-years across the galactic plane, and about one-fifth as much measured towards the galactic poles.

In this vast region, at great distances one from another, there are thirty thousand million stars,

[*Photo, Mt. Wilson Obsy.*

FIG. 3.
THE GREAT NEBULA IN ANDROMEDA (M. 31).
One of the least distant of the Island Galaxies, just visible to the naked eye; it is made up of some thousand million stars and much gaseous matter, and is the best known of these bodies.

according to the most recent calculations reported by Dr. C. G. Abbot of the Smithsonian Institution, Washington. As these are by no means equi-spaced, there are concentrations of stars here and there which, seen from another part of the galaxy, produce such beautiful effects as the "star-clouds" in Sagittarius or the "globular clusters" in Hercules and other parts of the sky. Within the galaxy, too, filling great regions of space around and between some of the stars, are the gaseous nebulae both dark and bright.

Returning now to the extra-galactic nebulae—the great gaseous objects and star clusters like islands in a three-dimensional ocean of space beyond the Milky Way—we are indebted to Dr. E. P. Hubble of Mt. Wilson Observatory for much new knowledge concerning them. In a recently published paper* he has given the results of a careful study of four hundred such nebulae. Some of the extra-galactic nebulae show no regularity of shape or structure. These form a sub-class by themselves, and to this class belong the Magellanic Clouds, great irregular star-clouds visible from the southern hemisphere like detached portions of the Milky Way, though actually as far away again. Far more numerous than the irregular nebulae are those having a definite shape or structure, the ellipsoidal and the spiral nebulae. The spectra of the former are so similar to the solar spectrum that there is no room for doubt that they are clusters of stars, even though the individual stars cannot be photographed. Possibly the stars are being gradually condensed out of the gases of which the nebulae were composed, and the residual gases act as envelopes rendering the star images indistinct.

Some of the nebulae are apparently at a transition stage between ellipsoidal and spiral, while yet others display well-developed spiral arms. The evidence seems strongly to point towards an evolutionary process as a glance at the illustrations will make clear—the gradual unwinding, the appearance of stars and star streams, the whole vast process of the development of island galaxies.

With this idea of progressive development in mind, the spiral nebulae are said to be of *early*, *intermediate* or *late* type, according as they present the appearance

[*Photo, Mt. Wilson Obsy.*

FIG. 4.
SPIRAL NEBULA (M. 101).
A very beautiful Island Galaxy in the constellation Ursa Major. Four hours exposure.

* "Extra-Galactic Nebulae." E. P. Hubble. *Astrophysical Journal*, December, 1926.

of the uncondensed nebula in Fig. 1, or intermediate forms between that and the well-developed, far-flung, stellar arms so clearly shown in Figs. 4 and 5.

The distances of some of the spirals have been determined in a very interesting way. These spirals contain stars, known as Cepheid Variables, whose light is not steady but fluctuates with perfect regularity, falling slowly from maximum to minimum and then rising rapidly to maximum. The light cycles usually have periods of a few hours or a few days. When studying similar stars whose true brightness was known, Miss Leavitt of Harvard Observatory discovered the fact that the longer the period of light variation the greater the intrinsic luminosity of the star. This relation was well established for the less distant stars, and it seemed so logical to expect stars with identical characteristics to obey the same law whether near or far, that it has been applied to stars in these remote galaxies. From a series of photographs, the period of light variation is found, then the established relation gives the true luminosity, and this, together with the apparent brightness on the photographs, gives the necessary data for calculating the distance.

[*Photo, Mt. Wilson Obsy.*

FIG. 5.

THE WHIRLPOOL NEBULA (N.G.C. 5194-5).

This spectacular spiral in the constellation Canes Venatici was first carefully observed by Lord Rosse and seen to be not merely a mass of glowing gas, but an aggregation of many stars.

It was by this method that Hubble determined the distance of the Great Nebula in Andromeda (Fig. 3) to be more than nine hundred thousand light-years. Another very large, bright spiral in the constellation of Triangulum was found by similar means to be at about the same distance. It is believed, however, that the thousands of fainter spirals are very much more distant. In Figs. 1 and 2 are shown two of the spirals in the region of the heavens designated by the constellation name Coma Berenices. Here, and in the adjacent region of Virgo, spiral nebulae are richly strewn on photographic plates of long exposure, and both Hubble and Shapley have estimated for some of these no less a distance than a hundred million light-years.

In spite of these tremendous distances much can be learned about the island galaxies, though, of course, the further away a galaxy is, the less up to date will be the news which the light brings. Thus, in the case of the Andromeda Nebula, approximately one million light-years distant, the rays of light which produced the image on the negative of Fig. 3 had been travelling through space for a million years, and consequently the picture we see is not Andromeda Nebula as it is to-day, but as it was one million years ago.

Just what it is like now we can only conjecture—probably not so very different from the picture, for one million years is less in the life of a star than one second of time in the average life of a man.

The radial velocities of the brighter nebulae can be determined by means of the spectroscope, and show that they are moving through space with great velocities. The Andromeda Nebula is approaching our galaxy with a velocity of 300 kilometres per second. Most of the spirals, however, are receding at speeds averaging 600 kilometres per second.

There are two ways of endeavouring to find out the total mass of a galaxy, and when two quite independent methods lead to results which are in good agreement the astronomer feels considerable confidence in the reliability of his calculations. The first method is based upon a speculation regarding the ratio of luminous to non-luminous matter in a galaxy and the theory that the luminosity is determined by the mass. When the absolute luminosity of a galaxy is known, its total mass can therefore be calculated. This method has been used by Opik, and gives for the Andromeda Nebula a mass nearly two thousand million times the mass of an average star like our sun. The second method depends upon the spectroscopic determination of the line of sight velocity of opposite edges of the nebula. If one side be found to be approaching and the other side receding, the only logical conclusion is that the whole nebula

is rotating. Now a rotating mass will fly asunder by centrifugal force unless some equal and opposite force hold its members together. If gravitation, acting towards the centre of the nebula, provide this balancing force, it is possible to calculate the total mass necessary to give rise to the restraining force required. The period of rotation of the Andromeda galaxy was found to be 17,000,000 years. From this its mass was calculated, giving just over three thousand million suns. The agreement with Opik's result is satisfactory.

Our picture of this best known island galaxy can be briefly summed up in a few words: A thousand million stars—like those in our own galaxy, some larger and some smaller than our sun—and much uncondensed gas, all forming the giant spiral nebula travelling through space at least 300 kilometres per second, and as it travels slowly expanding and unwinding its spiral arms, while as a whole it is turning round with solemn, majestic deliberation.

The Einstein Universe.

Men of science throughout all the ages have been obsessed with the idea that there is order in the Universe.* When the great wave of agnosticism passed over Europe, threatening to sweep the thoughts of men from all moorings, this fundamental tenet of scientific faith was the sheet anchor which saved mankind. So deeply implanted is this belief in natural law and order, that when some facts of astronomy and physics appeared to be incompatible with the current conception of the Universe, based as it is on the stately geometry of Euclid and the Newtonian mechanics, men of science were willing to consider throwing over the old conception and adopting a new conception suggested by Einstein. This willingness is the more remarkable when it is remembered that, to the non-mathematical mind, the four-dimensional spacetime universe of Einstein seems mysterious, fantastic, and unreal. Yet there is already considerable evidence in its favour, and so, generalizing from his detailed study of 400 galaxies, Hubble proceeds to evaluate the radius, volume, and mass of the Einstein Universe.

He calculates first the average density of space. If the matter forming all the stars and gaseous nebulae in our galaxy and in the 400 other galaxies studied by him were to be spread evenly throughout the space occupied by these galaxies, there would be a density of matter equivalent to one atom of hydrogen in every 300 cubic feet. He then evaluates the radius of curvature of spacetime, which, according to Einstein, depends only upon this average density and two constants, the velocity of light and the gravitational constant. This radius comes out to be five thousand billion astronomical units (5×10^{15} times the sun-earth distance). This value is a thousand times greater than that calculated by Silberstein from other relations and other data available three years ago.† Here in reality, as always metaphorically, the horizon recedes as knowledge increases.

What then is the total amount of matter distributed as stars and nebulae, in clusters and in galaxies, throughout this vast yet finite Universe? To express these figures in words is far too cumbersome, and so we set them forth in the elegant shorthand used always by the physicist and the astronomer—If M be the total mass of matter in the Einstein Universe, then

$$M = 1.8 \times 10^{57} \text{ gms.}$$
$$= 9.0 \times 10^{22} \text{ suns}$$
$$= 3.5 \times 10^{15} \text{ normal galaxies.}$$

In other words, there are about a thousand octillion (10^{51}) tons of matter, and were this to consist only of hydrogen there would be 10^{81} atoms.

How much real value these stupendous figures have, it is impossible to say. Firstly, they involve the Einstein conception of the Universe, not yet indisputably established. Secondly, they are conclusions regarding a Universe not one ten-millionth of whose volume can be explored by even the giant telescope at Mt. Wilson Observatory. If the distance of a galaxy exceed only one six-hundredth of the radius of curvature above mentioned, no telescope yet constructed can detect it. But a man will judge the world of humanity, their habits and characteristics, their comings and goings, by his knowledge of a few score individuals and his passing glimpses of a few thousand, and his conclusions will not be entirely valueless. So, too, the astronomer, with reliable knowledge of hundreds of stars and many nebulae, and glimpses of thousands yet more distant, will not refrain from speculation regarding the vast regions as yet beyond his ken—the ocean of space-time studded with a thousand billion glorious Island Galaxies.

* An interesting treatment of this subject may be found in "Science and the Modern World," by Dr. A. N. Whitehead.

† See "Measuring the Universe," *Discovery*, September, 1924.

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BY

A. VIBERT DOUGLAS, M. B. E., PH. D.

FROM THE SMITHSONIAN REPORT FOR 1928, PAGES 193–199
(WITH 5 PLATES)

(PUBLICATION 2984)

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ISLAND GALAXIES[1]

By A. Vibert Douglas, M. B. E., Ph.D.

McGill University, Montreal

[With five plates]

The knowledge that the heavens contain bodies that are neither planets nor stars is age old, for the keen eyes of the stargazers of civilizations long since gone did not fail to detect such objects as the nebulosity in the constellation of Orion and the small, hazy patch in Andromeda. But the significance of these objects remained a mystery for many centuries.

With the invention of the refracting telescope by Galileo about 1600, many of the apparently nebulous regions in the Milky Way were found to be resolvable into separate stars. These are so closely strewn in the sky that to the unaided eye their light is completely merged and blended. Toward the end of the seventeenth century the second great type of telescope was devised by Sir Isaac Newton, namely, the reflecting telescope, in which the starlight is brought to a focus not by a lens but by a mirror. About 150 years later, when the small pioneer telescopes of Galileo and Newton had given place to large and powerful instruments, Lord Rosse discovered that a certain nebulous region in the constellation Cannes Venatici when viewed through his great telescope was not merely a random, haphazard agglomeration, but a cluster of many stars distinctly grouped in the configuration of a spiral. (Pl. 5.) Thereafter the search for and discovery of other spiral nebulæ became one of the most fruitful tasks of the astronomer. From that time to the present, as a result of ever-increasingly powerful instruments, together with the introduction of photographic methods, many hundreds of spiral nebulæ have been found, and it is estimated that a thorough search of the entire heavens would disclose hundreds of thousands of them.

Speculation was at once begun. Could it be that all the nebulæ were in reality close assemblages of stars requiring only yet more powerful telescopes to show each star separately?

[1] Reprinted by permission, with alterations, from Discovery, Vol. IX, No. 99, March, 1928.

Sir William Huggins gave the decisive negative answer to this question—some of the nebulæ may be great clusters of stars, but there are others truly named nebulæ, for they are masses of glowing gas having the type of spectrum typical of gas whose atoms are radiating their characteristic quanta of energy.

Such is the nature of the great nebula in Orion and of many other nebulæ where vast regions of space are sparsely filled with gaseous matter. Where these gases are sufficiently excited they radiate the distinctive wave lengths of light associated with the atoms and molecules of which they are composed. Thus the spectroscopist identifies in these nebular spectra the unmistakable radiations of hydrogen and helium, often also nitrogen and carbon, and in addition to these he finds intense radiations which until recently were attributed to an unknown substance called nebulium. The mystery is now solved by Doctor Bowen, California, who attributes these radiations to oxygen and nitrogen atoms, radiating in an unusual manner as a result of their ionized condition and the low density of the nebulæ.

The gaseous nebulæ are not all sufficiently hot to radiate; some of them glow only because of the proximity of very bright hot stars; others are so cool that they absorb all the starlight that falls on them, thus forming great black patches in the sky. A famous dark nebula in the region of the Southern Cross is known as the "coal sack." A great American observer, the late Professor Barnard, made a systematic study of these opaque clouds, of which he listed over 180, varying from very small patches with sharp outlines to the long, irregular "dark lanes" so striking a feature of the constellation of Ophiuchus.

We know, then, that of the celestial objects originally called nebulæ some are vast clouds of gas occupying regions of space compared with which our solar system is absolutely insignificant; others are clusters of stars; while yet others, in particular the spiral nebulæ, are composed of both stars and gaseous nebulosity.

For a long time no one had any conception of the immensity of spiral nebulæ. They were thought of as comparatively small aggregations of stars within the great assemblage of stars surrounding our sun in all directions. The authors of the planetesimal theory drew an analogy between the arms of a spiral nebula and the arms of gaseous matter which they assumed to have been drawn out from the surface layers of our sun by the tidal forces produced by a passing star, these disrupted arms giving rise to the several condensations of matter which eventually became the planets of the solar system. Gradually, however, it became apparent that a spiral nebula was not to be compared with the solar system, but rather

with the whole galaxy of stars—our sun and the thousand million other suns which stud the heavens all around us.

There are known to be many thousand spiral nebulæ, and if each be comparable in size to our whole stellar galaxy it is obvious that they are not within it. They are in fact *island galaxies*. The term is here used to denote exactly the same thing as the term "island universes," which has become so common an expression in American astronomical writing. Since "universe" is defined as "all that exists, the creation and the Creator," its use in the plural seems unfortunate, especially as the word "galaxy" is quite adequate. Dignifying our stellar system by the name "*the* galaxy"—not merely because it is the system to which our sun belongs but for the more logical reason that as yet no other aggregation of stars is known to be quite as large—it then becomes natural to divide all nebulæ into two main classes, termed, respectively, the "galactic" and the "extragalactic" nebulæ.

Our galaxy is a gigantic aggregation of stars and gaseous nebulæ. It comprises all the stars visible to the naked eye and the many thousands more revealed by the telescope when used visually. These numbers are multiplied manyfold by the use of photography when stars so faint or remote as to be invisible leave the impress of their images upon the sensitive plate after many hours of exposure. The study of these photographs, counting the numbers of the stars of different magnitude or brightness and comparing the numbers in different parts of the sky, has shown that it is possible to make an estimate of their number and a representation of their distribution in space.

Even with the unaided eye it is evident that the distribution of stars is not spherically symmetrical. All along a great circle in the heavens the stars are more numerous than elsewhere, and this encircling band is called the Milky Way. The photographic plates reveal the same concentration, and so the Milky Way is called the galactic plane, while the directions at right angles to this plane, where the stars are less numerous and on the average less distant, are termed the galactic poles. Our sun happens to be situated not far from the center of this great lens-shaped cluster of stars. The dimensions of the galaxy are so vast as to be best appreciated when expressed in light-years, the unit so frequently employed by astronomers, equivalent to nearly 6,000,000,000,000 miles. Our galaxy is approximately 100,000 light-years across the galactic plane and about one-fifth as much measured toward the galactic poles.

In this vast region, at great distances one from another, there are 30,000 million stars, according to the most recent calculations of Seares and van Rhijn as reported by Dr. C. G. Abbot of the Smithsonian Institution, Washington. As these are by no means equi-

spaced, there are concentrations of stars here and there which, seen from another part of the galaxy, produce such beautiful effects as the "star clouds" in Sagittarius or the "globular clusters" in Hercules and other parts of the sky. Within the galaxy, too, filling great regions of space around and between some of the stars, are the gaseous nebulæ both dark and bright.

Returning now to the extragalactic nebulæ—the great gaseous objects and star clusters like islands in a three-dimensional ocean of space beyond the Milky Way—we are indebted to Dr. E. P. Hubble of Mount Wilson Observatory for much new knowledge concerning them. In a recently published paper [2] he has given the results of a careful study of 400 such nebulæ. Some of the extragalactic nebulæ show no regularity of shape or structure. These form a subclass by themselves, and to this class belong the Magellanic Clouds, great irregular star clouds visible from the Southern Hemisphere like detached portions of the Milky Way, though actually as far away again. Far more numerous than the irregular nebulæ are those having a definite shape or structure, the ellipsoidal and the spiral nebulæ. The spectra of the former are so similar to the solar spectrum that there is no room for doubt that they are clusters of stars, even though the individual stars can not be photographed. Possibly the stars are being gradually condensed out of the gases of which the nebulæ were composed, and the residual gases act as envelopes rendering the star images indistinct.

Some of the nebulæ are apparently at a transition stage between ellipsoidal and spiral, while yet others display well-developed spiral arms. The evidence seems strongly to point toward an evolutionary process, as a glance at the illustrations will make clear—the gradual unwinding, the appearance of stars and star streams, the whole vast process of the development of island galaxies.

With this idea of progressive development in mind, the spiral nebulæ are said to be of early, intermediate or late type, according as they present the appearance of the uncondensed nebula in Plate 1, or intermediate forms between that and the well-developed, far-flung, stellar arms so clearly shown in Plates 4 and 5.

The distances of some of the spirals have been determined in a very interesting way. These spirals contain stars, known as Cepheid variables, whose light is not steady but fluctuates with perfect regularity, falling slowly from maximum to minimum and then rising rapidly to maximum. The light cycles usually have periods of a few hours or a few days. When studying similar stars whose true brightness was known, Miss Leavitt of Harvard Observatory discovered the fact that the longer the period of light variation the

[2] Extragalactic Nebulæ. E. P. Hubble. Astrophysical Journal, December, 1926.

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It was by this method that Hubble determined the distance of the great nebula in Andromeda (Pl. 3) to be more than 900,000 light-years. Another very large, bright spiral in the constellation of Triangulum was found by similar means to be at about the same distance. It is believed, however, that the thousands of fainter spirals are very much more distant. In Plates 1 and 2 are shown two of the spirals in the region of the heavens designated by the constellation named Coma Berenices. Here, and in the adjacent region of Virgo, spiral nebulæ are richly strewn on photographic plates of long exposure, and both Hubble and Shapley have estimated for some of these no less a distance than 100 million light-years.

In spite of these tremendous distances much can be learned about the island galaxies, though, of course, the farther away a galaxy is the less up to date will be the news which the light brings. Thus in the case of the Andromeda nebula, approximately 1,000,000 light-years distant, the rays of light which produced the image on the negative of Plate 3 had been traveling through space for 1,000,000 years, and consequently the picture we see is not the Andromeda nebula as it is to-day but as it was 1,000,000 years ago.

Just what it is like now we can only conjecture—probably not so very different from the picture, for 1,000,000 years is less in the life of a star than 1 second of time in the average life of a man.

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THE EINSTEIN UNIVERSE

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He calculates first the average density of space. If the matter forming all the stars and gaseous nebulæ in our galaxy and in the 400 other galaxies studied by him were to be spread evenly throughout the space occupied by these galaxies, there would be a density of matter equivalent to one atom of hydrogen in every 300 cubic feet.

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What then is the total amount of matter distributed as stars and nebulæ, in clusters and in galaxies, throughout this vast yet finite universe? To express these figures in words is far too cumbersome, and so we set them forth in the elegant shorthand used always by the physicist and the astronomer: If M be the total mass of matter in the Einstein universe, then

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In other words, there are about 10^{51} tons of matter, and were this to consist only of hydrogen there would be 10^{81} atoms.

How much real value these stupendous figures have it is impossible to say. Firstly, they involve the Einstein conception of the universe, not yet indisputably established.[3] Secondly, assuming that the Einstein universe has a real significance, these figures are conclusions regarding a universe not one ten-millionth of whose volume can be explored by even the giant telescope at Mount Wilson Observatory. If the distance of a galaxy exceed only one six-hundredth of the radius of curvature above mentioned, no telescope yet constructed can detect it. But a man will judge the world of humanity, their habits and characteristics, their comings and goings, by his knowledge of a few score individuals and his passing glimpses of a few thousand, and his conclusions will not be entirely valueless. So, too, the astronomer, with reliable knowledge of hundreds of stars and many nebulæ, and glimpses of thousands yet more distant, will not refrain from speculation regarding the vast regions as yet beyond his ken—the ocean of spacetime studded with 1,000 million million glorious island galaxies.

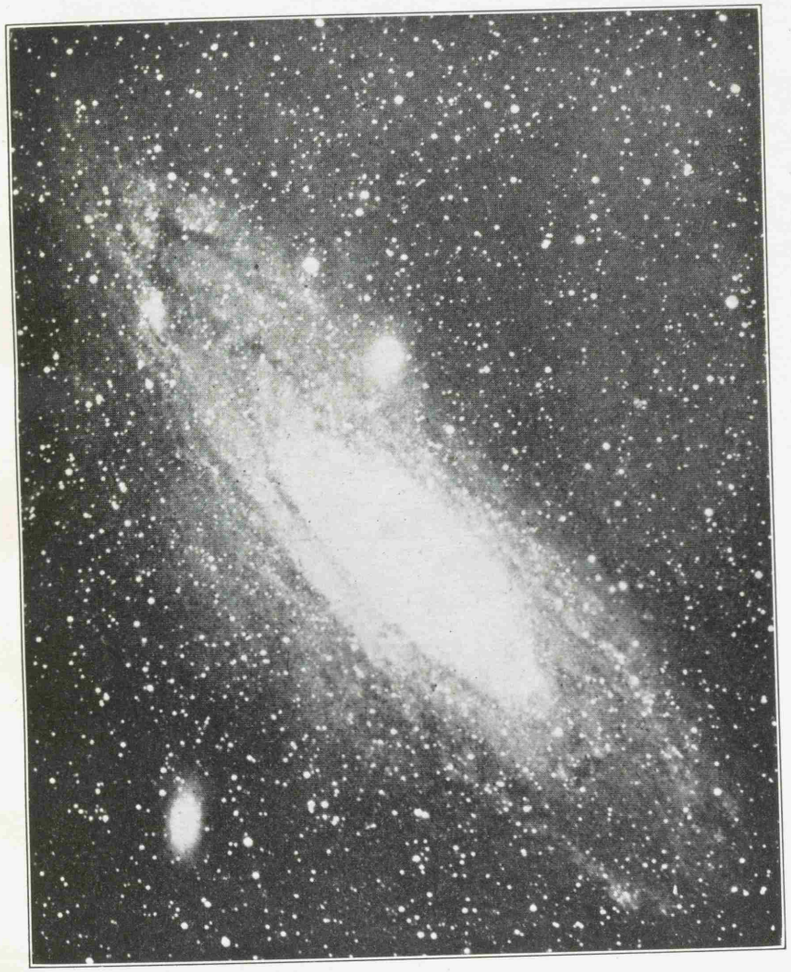
[3] Indeed there are many who reject the Einstein cosmology in favor of the modifications proposed by de Sitter, modifications which obviate some of the difficulties inherent in Einstein's cosmology. Doctor Silberstein, for example, denies any reality to the above figures, retaining confidence in his own value of the radius of curvature based upon his deductions from the de Sitter equations.

ISLAND GALAXY (M. 64)

An early type spiral nebula in the constellation Como Berenices

ISLAND GALAXY (H. V. 24)

Edge-on view of a spiral nebula in the constellation Coma Berenices. Five hours' exposure. Foreground stars are in our Galaxy and the brighter ones are distorted by overexposure



THE GREAT NEBULA IN ANDROMEDA (M. 31)

One of the least distant of the Island Galaxies, just visible to the naked eye; it is made up of some thousand million stars and much gaseous matter, and it is the best known of these bodies

THE WHIRLPOOL NEBULA (N. G. C. 5194-5)

KEPLER'S DREAM*

By A. Vibert Douglas
Kingston Centre, R.A.S.C.

The author of this book, science editor of the *Saturday Review* and onetime American correspondent for the *New Scientist*, has brought to our attention an almost completely neglected work of John Kepler. In 1609 Kepler announced the first two laws of planetary motion and in the same year he completed in the form of an allegory *Somnium sive astronomia lunaris*, a dream of travel to the moon from Iceland, island of myth and fable with enough history to stir the imagination.

Lear believes there was a three-fold purpose in Kepler's mind. As a scientist familiar with Plutarch's speculations on the mountainous surface of the moon, he considered it not impossible that life existed there, whether similar to earth's inhabitants or dissimilar he refrained from speculating. The gravitational and physiological difficulties to be overcome in transporting a man to the moon he outlined with amazing insight. He estimated the distance as 50,000 German miles and the time of travel would have to be four hours. The uncertainty of the true value of the German mile places the lunar distance between 202,960 and 233,404 statute miles. He realized that a tremendous initial velocity would be required to overcome surface gravity, that a no-gravity point would be reached, followed by a lunar gravitational pull against which some form of braking force would be necessary to avoid a crash landing. He wrote "the road is seldom open; the journey could be made only by men willing to take grave risk to life". No inactive persons, nor fat ones, nor pleasure-loving ones may go, only "those who have spent their lives on horseback or have shipped often to the Indes and are accustomed to subsisting on hardtack, garlic, dried fish and unpalatable fare".

The first hazard is solar radiation, the intensity of which increases "ferociously" above the earth's mountain tops, below which it has been filtered by the atmosphere. The journey should therefore be made at a time of lunar eclipse when the cone of shadow thrown by the earth forms a tunnel to the moon within which travellers would be safe. Hence the time of travel must be not much over four hours.

The path to be followed would not be the straight line between the two bodies but the line from the earth to that point in space where the moon and

**Somnium sive astronomia lunaris*, Joannis Kepleri by John Lear. pp. 182, University of California Press, 1965. $1.50.

the travellers would meet. Timing is of the utmost importance for delay caused by having to tarry in the earth's shadow waiting for it to reach the surface of the moon would place undue strain on the "emotional tolerance" of the traveller.

The quick violent thrust of take-off would be very hard on the voyager who would be "twisted and turned as if shot from a cannon ... he must be arranged limb by limb so that the shock will be distributed over the individual members". He should be given narcotics and opiates for the first stage of the journey. The next difficulty will be terrific cold and trouble in breathing.

On arrival at the lunar surface he will hasten to one of many caves for protection against the full glare of the sun as the earth's shadow moves off. The surface is honeycombed with caverns. Large bodies of water fill the vast depressions and are subject to tides due to the pull of earth and sun. Kepler refers to the earth as Volva and the lunar hemisphere always facing the earth as Subvolva. The side from which Volva is never visible he calls Privolva. When both sun and earth are over Subvolva the waters are drawn around from Privolva, but when the sun is over Privolva, some of the water flows back into the basins of that hemisphere. Obviously the general idea of universal gravitation was a familiar one to Kepler half a century before Newton's mathematical formulation of the law.

Detailed descriptions are given of the lunar "day" and "night" and of the appearance of Volva as seen by an observer on the moon, diurnal and annual changes, and eclipses of earth and sun,

The second purpose in Kepler's mind in writing all this as an allegory was "to work out through the example of the moon an argument for the motion of the earth" and to do this in a way that would "spread word of Copernican science" without arousing enemies of science within the Church. By introducing spirits ... he hoped to muffle the metaphysicists in their own jargon". Unfortunately, his allegorical language was misinterpreted by his antagonists leading to the charge of witchcraft laid against his mother. Kepler therefore spent much time during the last years of his life writing explanatory notes to his *Dream*. Fiolxhilde is not his mother but the mother-image of Ignorance. Her precocious son Duracotus (who makes the journey to the moon) represents Science. The nine spirits whom Fiolxhilde calls up are the nine classical muses associated with metaphysics, natural science, ethics, astronomy, astrology, optics, music, geometry and arithmetic. The Daemon whom she summons to her native Iceland from the moon represents the spirit of Knowledge. In 1634, four years after Kepler's death, his son succeeded in getting the *Dream* and the more than 200 *Notes* published, but the book made little impression and remained almost forgotten. Lear's book reproduces in full the translation from the Latin by Patricia Frueh Kirkwood.

The third motive, perhaps a rather far-fetched one, Lear believes to have been a political one, an effort by Kepler to divert the warring factions of the Emperor Rudolph and his brother Archduke Matthias from pursuing a destructive war by turning their minds to the sublime quest for truth about the great problems of astronomy.

The book is well produced, the only error noted being a numerical slip on page 51 where a wrong value of π is given. Kepler describes his *Dream* as lunar astronomy but John Lear usually prefers to call it lunar geography.

In 1610 Kepler wrote an open letter to Galileo informing him of his lunar speculations and deductions, making this prophecy: "Provide ship or sails adapted to the heavenly breezes and there will be some who will not fear even that void ... So for those who will come shortly to attempt this journey, let us establish the astronomy: Galileo, you of Jupiter, I of the moon". Three and a half centuries later this dream has become a reality.