

A. Vibert Douglas

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BETWEEN THE STARS

BY A. VIBERT DOUGLAS

I

ASTRONOMY has made great headway in recent years in the measurement of star distances, not only by the direct methods of trigonometrical survey, but by various statistical and spectroscopic methods, the results of which have justified the various assumptions involved. The result of all this laborious work has been to present a picture of the galaxy of ten thousand million stars surrounding our sun so vast that its emptiness is the first characteristic to attract attention. Three or four minute minnows with the whole Atlantic Ocean as their swimming pool — such similes have been employed to convey some idea of the vastness of interstellar space.

It has long been realized, however, that interstellar space is not entirely empty — in other words, it is not a true vacuum. There is a certain amount of scattering of light traversing these 'empty' regions. This attenuation can only take place if interstellar space contains at least an occasional atom or free electron. Photographs of various regions of the sky, particularly the Milky Way, show that there are vast regions so densely filled with gaseous matter that the light from the stars beyond is almost if not completely absorbed. Some of these gaseous nebulae have comparatively clean-cut boundaries, whereas others have no apparent boundary, their densities growing gradually less and less until normal sky background is reached.

This points directly to the conclusion that there may be and probably is finely scattered matter throughout the whole of interstellar space.

This hypothesis was first discussed in a thorough manner about four years ago when Professor Eddington made it the subject of the Bakerian lecture for that year. With weighty arguments, he set forth the theory that interstellar space is not empty but full of matter. This word 'full' is, of course, used not in its absolute sense of containing so much that no more could be contained, but in the relative sense that there are no vast regions completely devoid of all matter; there are in fact so many atoms dispersed throughout space that there is probably one in every cubic centimetre of space at any instant.

The observational confirmation of this interesting hypothesis has been gradually accumulating and forms one of the most graphic stories which modern astrophysical research has produced. Like many another important discovery, it made its appearance as an incidental and perplexing exception to a general rule in quite a different problem.

II

Sir William Huggins, half a century ago, considering the change of pitch of a sound produced by the motion of the source of sound or of the hearer or of both relative to one another, — a phenomenon carefully investigated by the Austrian physicist, Doppler, after whom it is called, — drew attention to

the analogous effect on the color or wave length of light by proposing to use this measurable shift of the spectrum lines to violet or to red, as the case might be, as a means of determining the velocities with which individual stars are moving toward the solar system or away from it. This method of studying stellar motions was taken up by all the leading observatories, which equipped themselves with spectrographs for this purpose, and to-day the radial velocities of many thousands of stars have been measured and recorded.

One of the early workers in this line was Dr. Hartmann of Potsdam, who announced that there was something apparently inconsistent about the behavior of the lines due to calcium in the spectrum of certain stars. These two particular lines known to spectroscopists as the H and K lines were not displaced to red or to violet as were the other spectrum lines. Here was a mystery! A star that was moving rapidly toward us, for example, would show the characteristic shift of the lines in its spectrum toward the violet — that is, all its lines except these calcium ones and sometimes also a line due to sodium.

Other astronomers soon found the same thing and very soon theories were devised to explain the presence of these 'stationary' lines, as they were at first called. Just as the earth moving in its orbit carries with it on its flight through space its own surrounding atmosphere of cool gases, so, too, a star carries with it a vast atmosphere of gases which surround its intensely hot inner gases. It is when the light, or, more generally speaking, the radiations bursting forth from the hot interior of the star, pass through the relatively cooler gases of its own outer atmosphere that certain specific radiations are absorbed by the atoms composing this atmosphere, thus producing the dark lines in the spectrum of the starlight — and these lines

by their position in the spectrum indicate the velocity of the star relative to the earth. But now suppose that the star were moving not through empty space but through a vast cloud of highly dispersed gases, so that light leaving the star passed through millions upon millions of miles of this gas on its journey toward the earth. If this gas were in part composed of atoms of calcium in the state of positive electrical charge which renders them capable of absorbing radiation, then the H and K absorption lines should be found in the spectrum of the starlight in addition to all the lines due to absorption by the atoms in the star's own atmosphere; but whereas the latter, the true stellar lines, will be displaced according to the radial velocity of the star, the former or interstellar lines will be unaffected by this velocity.

The question then arose as to the origin and extent of these 'stationary' clouds of calcium and no doubt other gases, as there is no reason to suppose that all the elements known to science are not represented in interstellar space. Are they due to expulsion of matter from the giant stars that are moving through these regions? Or might they be the last remnants of the great nebula from which the stars have been slowly formed by gravitational aggregation?

More light was thrown on the question when Dr. Struve of the Yerkes Observatory showed that the more distant the star from the solar system the more intense were the 'stationary' lines in its spectrum. This pointed unequivocally to the hypothesis that this gaseous cloud extends throughout interstellar space.

The word 'stationary' was soon shown to be inaccurate by several astronomers who found that these lines were not usually completely undisplaced in the spectrum, though they

were not shifted to the same extent as the true stellar lines, and the terms 'detached' lines or 'interstellar' lines have now been adopted to replace the obsolete adjective.

The crowning discovery was made when it was shown that the residual shifts of these detached lines can be explained if the vast interstellar cloud of gases and the ten thousand million stars which are moving about within it are all taking part in a majestic rotation. This subject formed part of the George Darwin lecture delivered by Dr. J. S. Plaskett before the Royal Astronomical Society in May of this year, when this eminent Canadian astronomer discussed the observations made by himself and his associates at Victoria, B. C., observations which are considered by many to provide very strong confirmation of the hypothesis of galactic rotation.

III

It is interesting to consider that at any point in interstellar space 'wireless' messages from all the myriad stars known to modern astronomical photography might be intercepted. And not only from the myriads of stars forming the galaxy about us, but from the thousands of other galaxies, the so-called spiral nebulae, so remote that, though each is probably an assemblage of a thousand million stars, yet only one is sufficiently near our own galaxy to be seen with the unaided eye. Every message, wireless or otherwise, involves a transfer of energy. Hence, at every point in space, energy from every star and every galaxy is rushing past at the characteristic speed of all radiant energy, 186,000 miles per second. Yet such is the marvelous nature of space that there is no interference, no blending, no merging, no loss of identity of a single one of the innumerable messages

that are rushing past each point in every possible direction.

Space, empty space, completely devoid of matter, offers no hindrance to the passage of light or heat or any other form of radiation. Each unit or 'quantum' of radiant energy flashes through space like a projectile, yet accompanied along its route by electrical and magnetic disturbances of an undulatory character which suggest the physical picture of wave motion. To complete the picture, to give the mind a tangible representation of radiation passing through space like waves in the ocean, physicists invented the term 'æther,' a hypothetical, immaterial *something* coextant with space. Whether this conception has on the whole helped matters or whether it has merely introduced an unnecessary complexity is a debatable point; but the term is generally understood to mean that immaterial medium filling all space, intergalactic as well as interstellar, through which radiation flows, offering no resistance to its progress, nor indeed to the motion of material bodies whether atoms or aggregations of vast millions of atoms in the form of stars. There have been, it must be added in qualification of the last statement, a few men of science who conceive of the æther as having a viscous property resisting the motion of material bodies like stars and planets; but until incontrovertible experimental evidence is forthcoming the majority of physicists will regard the æther as little if anything more than another name for space.

Radiation only runs the risk of being interfered with on its journey through space when it encounters material particles such as these atoms of calcium that we have seen to be diffused throughout the interstellar regions. An atom may absorb the energy of a radiation falling upon it, or it may simply scatter or deviate it from its

course. This obviously is why the astronomer has been able to detect the presence of interstellar matter at all.

IV

Apart altogether from the mysteries with which matter and radiation are surrounded, there is the great challenging fundamental question, What is the nature of space? We are apt to feel that it must be so obvious to everyone just what space is that it is unnecessary to essay the exceedingly difficult task of putting our notions into words. But space, it seems, is not so simple. A ray of light starting out in a certain direction, even if it encountered no matter whatever in interstellar space to dissipate its energy and scatter it to the four winds, would not continue forever in the same straight line away from its starting point (using the term 'straight line' in the sense in which we use it in everyday life). It would, in fact, according to the great thinkers who follow the lead of Einstein, tend to curve round and ultimately come back to its source. Hence space is said by these investigators to be finite though unbounded.

The longest possible path that a ray of light can travel is not infinitely long, the number of stars in the entire universe is not infinitely great, the total energy in the universe is not infinite in amount — and yet on the wings of light, or indeed on the wings of reasonable thought, there is no place to which you might roam where you would feel yourself to be at the edge or boundary of space. You might imagine yourself leaving this solar system, leaving this galaxy of ten thousand million stars, visiting any other of the far-away galaxies, or visiting any point of intergalactic or perhaps even we might say of extragalactic space, yet nowhere having any reason to feel that space

did not stretch out equally all around you.

This sounds not only absurd but quite contradictory. Can there be any truth in it? The explanation of the cosmologists involves a four-dimensional line of argument logically apparent to the mathematician but outside the limits of visualization. The words 'curvature' of space and 'warping' of space are used in an attempt to convey by analogy with the three-dimensional objective world of our experience some idea of the state of things in this hypothetical space of the mathematician. It is due to the 'curvature' of space that light travels in a great orbit in space devoid of matter, and that near to a massive star it is swerved from this path because space near a concentration of energy in the form of matter is more highly 'curved.' For the same reason a small body like a planet revolves about its sun, not because the more massive sun pulls it inward continually (as Newton explained the phenomenon), but because space itself, under the mutual influence of sun and planet, is 'curved' or 'warped' so that the orbit is the natural path of least resistance for the planet to move in.

The justification for the belief that this hypothetical space of the mathematician more nearly represents actual space than does our (so-called) 'common sense' idea of space is that the former overcomes certain difficulties and incongruities that both physicists and astronomers had discovered when attempting to harmonize some facts of observation and experiment with the older 'common sense' idea of space.

V

At this stage, when physicists and astronomers have been feeling their way painfully and by devious paths, blazed out for them by three or four

pioneer cosmologists, toward a satisfactory theory of space, a new and quite startling discovery has been made in the realm of theoretical research. Space, which according to the views of these thinkers was to be thought of as unbounded but of finite volume, is possibly capable of expansion or of contraction. This theoretical possibility considered in conjunction with the astronomical fact of the recessional velocities of the spiral nebulae points to the extraordinary conclusion that the universe is slowly expanding — space itself is increasing in volume.

Chapter One of this universal detective tale was published in 1927 in a Belgian scientific journal, the author being Abbé Lemaître, but its significance lay unappreciated for two or more years. Chapter Two was written by Professor Eddington and published only a few months ago. His calculations point to an expansion of space at the rate of double the radius in fourteen hundred million years. This means that superimposed upon the individual motions of stars and of stellar galaxies there is a gradual drifting apart going on all the time. The astronomers of some far-distant date will have even less chance than those of to-day of finding out the secrets of the spiral nebulae, unless they discover much more delicate and sensitive instruments than any in use at the present time, for this ever-increasing remoteness means that gradually these other galaxies will

pass beyond the limits of detection by even the most powerful telescopes yet constructed.

Chapter Three of this strange tale may be expected, perhaps, from the pen of Professor de Sitter. Subsequent installments are certain to follow from other pens, but what they may disclose is beyond conjecture.

How can these things be? The age-long question recurs and the classic reply has never been improved upon: 'The wind bloweth where it listeth, and thou hearest the sound thereof, but canst not tell whence it cometh, and whither it goeth.' It is not only the matters of ultimate importance, the questions of spiritual truth, that are surrounded by mystery. The world of nature around us is everywhere thus enfolded. Mystery should challenge us, not dishearten and depress us.

Mankind may be pardoned for having so long believed in two fundamentally simple starting points of thought — space and time. Now these too have been shown to be far from simple, nor can they be dissociated the one from the other. The mystery of life, the mystery of matter and radiation, the mystery of 'spacetime' — which is the greatest, or are they perhaps not three mysteries, but one? 'Behold, I show you a mystery' — much more remarkable would it be to be shown something that was not a mystery! But would it really interest us?



Dr. W. Cullis, C.B.E.

THE

Chronicle

1957-58

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BRITISH COLUMBIA (from page 8)

toria, urged those present to take increased interest in the work of their Alumni Clubs and stressed the need for more women in the U.B.C. Senate.

The following recommendation was approved: "Whereas resolutions from the C.F.U.W. arrived too late for consideration, therefore the New Westminster Club recommends that the National Council forward resolutions to clubs no later than April first."

Mrs. F. E. Bertram and the third group from Chilliwack discussed mass education and the new teacher training program of the B.C. College of Education, under the title, "Is this it?"

At the close, delegates were guests of Mrs. Ross for tea at Government House — a delightful climax to a worthwhile gathering.

ALBERTA (from page 9)

Delegates were entertained in the evening by the Medicine Hat Club at a buffet supper at the home of Mrs. H. Hovey.

To Mrs. Kidd, President of the Medicine Hat Club, and to Mrs. G. Ross Gibson, Chairman of the Planning Committee, went hearty thanks for the excellent arrangements made for the meeting. The day's entertainment concluded with a movie of the Edmonton Triennial, 1955, in which many of us saw ourselves as unconscious film stars!

EASTERN ONTARIO (from page 11)

With Miss Alice Miller of the McGill Alumnae as moderator, members from Arnprior, Smiths Falls and Belleville referred to admission to university and the apathy of women students to post-graduate employment, in relation to education.

With Miss MacLellan as moderator, members of the Ottawa Club concerned themselves with the Ontario Succession Duties Act. The result of this discussion was the recorded wish of the Conference to endorse the Resolution to amend the Ontario Succession Duty Act.

The Conference also passed a resolution that the individual clubs be urged to set up a special committee to make a survey of Jury Service for women in their communities.

As a result of a most interesting talk by Mrs. Gilleland on the Ontario-St. Lawrence Development Commission, the Conference also endorsed the request to the Provincial Government to preserve certain buildings in the area which is to be flooded, and to put these buildings to practical use in the new Canadian Village or Park Area.

Miss McCulloch of Peterborough outlined the proposed work to be done on the preservation of the Serpent Mounds discovered in that area. On Sunday guests toured the Serpent Mound Area.



Mrs. J. J. McKeever, Peterborough
 Mrs. D. I. MacKinnon, Belleville



At the Tenth Conference of the I.F.U.W. held in Zürich, 1950, Dr. Cullis was followed by Dr. Edith Batho, Great Britain, Dr. Louise Pearce, U.S.A., and Dr. Marion Grant, Canada, as national leaders presented histories of their organizations to Dr. A. V. Douglas, I.F.U.W. President, 1947-50, assisted by Miss Bowie, Vice-President.

Dr. WINIFRED CULLIS, C.B.E.

University women of Canada join with friends in many countries, and particularly in Great Britain, in saluting the memory of a great woman — Winifred Clara Cullis who passed away in London on November 13, 1956.

Born in Gloucester in 1875, educated at Newnham College, Cambridge, in the Natural Sciences, she became demonstrator (1901), lecturer (1903) and Professor of Physiology (1919) at The London School of Medicine for Women. Throughout the years, including one session (1917-18) at Toronto, Dr. Cullis inspired hundreds of medical students, colleagues and friends by her buoyant and vigorous personality, scientific integrity, enthusiasm for her subject, as well as by her contagious interest in a wide range of activities. Loyal and true to scores of friends, she was also uncompromising to those who, rightly or wrongly, roused her ire.

She worked energetically on the board of the Chelsea Polytechnic Institute, on the educational programme of the Royal Academy of Dancing, and participated in many activities of the English-speaking Union; she supervised the production of educational films on physiology and participated in BBC broadcasts; she joyfully undertook lecture tours on four continents, especially during and after World War II for the Ministry of Information, addressing servicemen and civilians, always captivating her audience by her voice and presence and by her skilful apparently artless combination of a matter-of-fact with a restrained dramatic presentation.

A profound believer in equal educational and professional opportunities for men and women, she had become an active member

of the British Federation of University Women, and was made chairman of the Committee on International Relations early in 1919 when Professor Caroline Spurgeon returned to London from New York, where she and Dean Virginia Gildersleeve had agreed that the time was ripe for the formation of an International Federation of University Women.

In the spring of 1919 in Dr. Cullis's School of Medicine, with Dean Gildersleeve heading the American delegation, the I.F.U.W. came into being. At the London Conference in 1920 these two took the chair alternately until Professor Spurgeon was acclaimed President. Nine years later Professor Cullis became the fourth President. Her interest in the I.F.U.W. never flagged. She attended almost every Conference including Paris 1956 and many Council meetings. The I.F.U.W. Winifred Cullis Grants to encourage research will continue to honour her name.

Her name will live also in and through the timbers, stones, brick-work and spirit of historic Crosby Hall which she deeply loved and for which she devotedly laboured. It was when she was campaigning in 1921 for funds to purchase Crosby Hall that I first met her at a B.F.U.W. meeting in Cambridge. To the end of her life she lost no opportunity to appeal for Crosby Hall scholarships which would bring scholars of many nations to reside in that famous international centre.

I think of her delight in recalling the council meeting in Prague in 1930 when she received from President Masaryk his gift of £1000 towards the I.F.U.W. research fellowship. I see her at Stockholm in 1939 chatting genially at the final dinner at Skaansen with delegates from countries so soon to be submerged under black waves of aggression. I recall her happiness when members from several countries, some of them after tragic years of occupation and hardship, were able to meet in Zürich in 1946 to plan the work of relief and re-organization of the Federation. I smile again at the grimaces on her mobile expressive features in 1949 as she yielded to the pressing invitation of a Copenhagen judge that she venture to smoke a Danish cigar! I hear^{ed} at the reception in Zürich in 1950, after the presentation of the national histories of the First Thirty Years, recounting with vigour and humour the earliest days and personalities of the I.F.U.W. And finally in Paris just three months before her death, at her last I.F.U.W. Conference, whether in the Grand Amphithéâtre of the Sorbonne, or at the Municipal Reception at the Hôtel de Ville or at the Farewell Party at Reid Hall, what a striking figure she was!

Great men and women are the ornament of their times — Winifred Cullis belongs among this company. She was, in Caroline Spurgeon's metaphor from Bacon, a Merchant of Light in a world which needs light — the Light of Truth and Understanding.

A. V. Douglas

University Women in Many Spheres



DR. A. V. DOUGLAS, Kingston

In her recent biography of Sir Arthur Stanley Eddington, Dr. A. Vibert Douglas, Professor of Astronomy and Dean of Women at Queen's University, Kingston, has sketched the "faithful likeness" of a great thinker — the man, reserved, deeply religious, finding relaxation in simple pleasures, but the man of science, "one of the super-giants in an age of giants", whose powerful mind and discerning vision place him in the vanguard of those who search for truth through scientific investigation. The four scientific chapters of this book constitute in themselves a page in the history of scientific thought during the first four decades of this century.

University women will be charmed and stimulated by this sympathetic and scholarly portrayal from one who knew the great scientist as teacher and research associate.

Dr. Douglas was the Canadian president of the International Federation of University Women 1947-1950, and later Chairman of the Fellowship Committee.

DR. MABEL F. TIMLIN, Saskatoon

In the fields of economic theory, money and banking, and immigration, Dr. Mabel F. Timlin, Professor of Economics at the University of Saskatchewan has had a spectacular career. After her arrival in Canada from the United States during the First World War, teaching, business courses, and secretarial duties were merely stepping-stones to her Bachelor's degree at the University of Saskatchewan and her doctorate from the University of Washington in 1940, her major thesis being on Keynesian monetary theory.

She held a Guggenheim Fellowship in 1945, taught at the Canadian Summer Seminar in Ponnigny, France in 1950, and was invited as one of thirty experts from fifteen countries to attend the Round Table Conference of the International Economic Association at Kitzbuhel, Austria, in 1955. This year she is with the Summer Research Group of the Commonwealth Studies Centre at Duke University, North Carolina.

C.F.U.W. members know Dr. Timlin as one of the Canadian representatives on the International Fellowships Award Committee of the I.F.U.W. 1948-56, and she is still on the panel of 'experts' for consultation.



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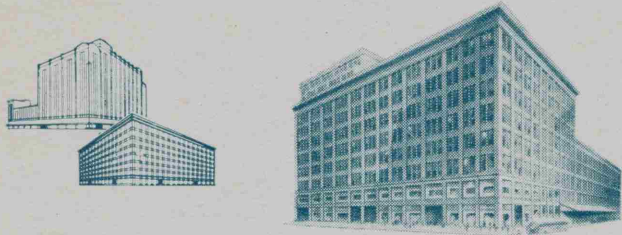
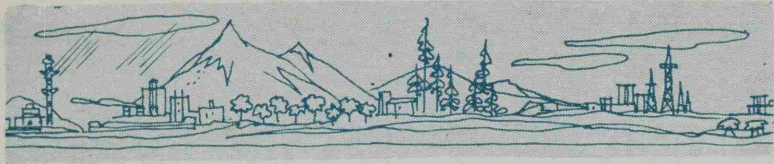
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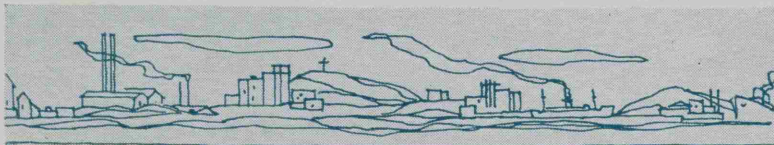
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THE CYANOGEN BAND NEAR λ 4200 IN THE
SPECTRA OF THREE CEPHEID VARIABLES.

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

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THE CYANOGEN BAND NEAR λ 4200 IN THE SPECTRA
OF THREE CEPHEID VARIABLES.

(Plates 15, 16.)

BY

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

The Cyanogen Band near λ 4200 in the Spectra of Three Cepheid Variables. By A. Vibert Douglas, M.B.E., Ph.D. (Plates 15, 16.)

(Communicated by the Secretaries.)

1. Cyanogen has two well-known bands at λ 4216 and λ 4197. In stellar spectra a wide absorption band extending from about 10 Å to as much as 40 Å on either side of λ 4200 has been recorded by various writers during the past six or seven years. The attribution of this band to cyanogen molecules in the stellar atmospheres has been made by several astrophysicists at one time or another and appears to be a justifiable assumption at the present time.

The presence of this band in the spectra of A-type stars had been noted by the writer, who tried in 1925, but without success, to make it the basis of a method of estimating absolute magnitudes, since Lindblad had successfully used the cyanogen bands in region $\lambda\lambda$ 3883-3935 for this purpose. Subsequently the band was studied in some F and G stars of the Cepheid variable type, and a cyclical variation in intensity was discovered.

Interest has been stimulated in the band by papers by Shapley*

* *Harvard Circ.*, 317, May 1928. *Harvard Bul.*, 862, Dec. 1928; 864, Feb. 1929.

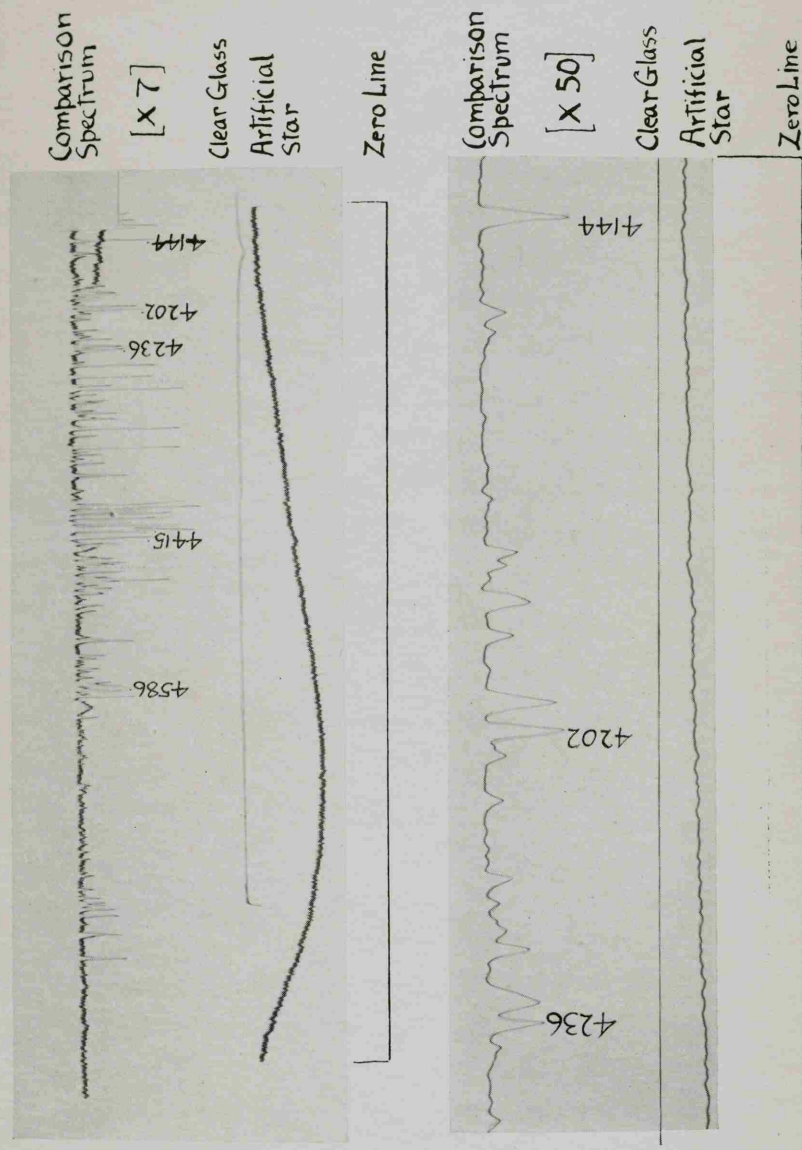


Fig. 1.—Transmission of light by optical system of 15-inch refractor of the Dominion Observatory.

and by Elvey.* The latter in his paper refers to what has been previously reported in regard to this band, and goes on to show that as it appears on the spectrograms of the Yerkes Observatory (Bruce spectrograph and 40-inch refractor) the band can be fully accounted for by selective absorption in the glass of the optical system. It is therefore desirable that any data tending to re-establish or confirm the true stellar origin of the band should be recorded.

2. Since all the spectrograms which formed the basis of this study of the behaviour of the λ 4200 band were obtained from the Dominion Observatory, Ottawa, it was essential that the selective absorption, if any, of the optical system of the spectrograph and 15-inch refractor of that institution should be determined.

By the courtesy of the Director and with the kind assistance of Miss M. S. Burland of the Dominion Observatory, the writer was able to test the system in the following manner. A 1000-watt Mazda lamp was attached to the dome and exposures were made of various durations up to five minutes. The plates were developed and subsequently put through the microphotometer in exactly the same manner as for the stellar spectrograms. The resulting microphotometer tracings show no sign of selective absorption in the region about λ 4200, and indeed the transmission throughout the range λ 4100 to λ 4800 is remarkably smooth.

In fig. 1 two tracings are reproduced, one having a linear magnification of $\times 7$, the other $\times 50$, the comparison spectrum in each case being iron and vanadium. The other exposures yielded equally smooth tracings, so that it can confidently be asserted that the absorption in the neighbourhood of λ 4200 on Dominion Observatory spectrograms is not an instrumental effect but an example of true stellar absorption.

3. The assignation of this stellar band to the molecule CN is less certain though not improbable. The question of its being due to some molecule other than cyanogen does not appear to require discussion at the present time.† It might be objected, however, that it was in reality merely a spurious band due to the overlapping of the wings of closely adjacent arc or spark lines, or a mixture of the two. This possibility requires careful consideration.

As will be seen in the three sections following, the intensity of this band in the spectra of three Cepheids varies with the phase of the star in each case. This cyclic variation, moreover, is found to be very nearly in phase with the periodic variation in intensity of a large number of typical enhanced lines and of the Balmer lines of hydrogen; and distinctly out of phase with the variations in intensity of the well-known Fraunhofer G band near λ 4300, whose identification with the hydrocarbon molecule CH seems to be fairly certain.‡ This would seem to point to the possibility that the λ 4200 band was an ionization effect. A glance, however, at Table I. will show that the central region of the band, $\lambda\lambda$ 4198–4202, is by no means rich in strong arc lines of stellar

* *Ap. J.*, 70, 243, 1929.

† *Int. Crit. Tables*, 5, 412, 1929.

‡ *Ibid.*

importance and completely devoid of intense spark lines. The data here given are taken from Kayser's *Tabelle der Hauptlinien der Linien-spektra*.

TABLE I.
Spectrum Lines near λ 4200.

λ in I. A.	Element.	Intensity.	
		Arc.	Spark.
4198.313	Fe I.	6	3
98.52	Cr	3	2
98.72	Ce	5	6
98.88	Ru	4	3
99.09	Zr	6	3
99.10	Fe	6	5
99.29	Y II.	3	3
99.91	Ru	10	10
4201.73	Ni	5	..
01.81	Rb I.	8	7
02.03	Fe I.	7	6
02.44	V	1	8

In marked contrast to this portion of the spectrum is the region $\lambda\lambda$ 4446-4476, where a spurious band is actually produced as a result of the confluence of the wings of more than thirty strong arc lines which are very closely crowded in this region. The variations in intensity of this spurious band, discussed in § 5 below, make it apparent that the λ 4200 band is unlikely to be due to any such cause.

In the absence of any evidence to the contrary, therefore, the band will be regarded as due to stellar cyanogen.

4. *η Aquilæ.*—This star has a period of $7^d.176$; a light variation from $3^m.7$ to $4^m.5$; and a range in spectral class from F2 to G9, the average spectrum being given in the Henry Draper Catalogue as Gop. The variations in intensity with phase, of the Balmer lines and a score of typical enhanced lines as well as of the G band, were determined* recently as far as it is possible to do this from unstandardized plates. The hydrogen and enhanced lines are most intense near the phase of maximum light, whereas the G band is increasing in intensity at minimum light when ionization is less pronounced. This is in full accord with theoretical expectation, conditions favourable to increased ionization being favourable also to dissociation of a molecule, and conversely.

It soon became apparent that the cyanogen band, clearly defined on the majority of the microphotometer tracings of some sixty spectrograms and extending in general from λ 4194 to λ 4212, undergoes a similar variation in intensity, but out of phase relative to the variation of the G band.

* Henroteau and Douglas, *Pub. Dom. Obs.*, ix., 7, p. 163, 1929.

Fig. 2 shows this very clearly. Absolute measures of intensity were obviously impossible, but relative intensities throughout the period were considered to have been obtained by measuring on each tracing the depth of the band below the smooth curve representing the continuous background, and also the depth of an insensitive, closely adjacent line, and then taking the ratio of the two. The G band curve is thus determined by the mean values of the ratio G/λ 4289 plotted against phase, and the CN curve likewise for the ratio CN/λ 4213. That the resulting curves represent the variations of the numerators rather than the denominators of the ratios is tested by trying out various other lines as the basis of comparison from one tracing to another. Thus in fig. 4 the line λ 4198 is used in addition to λ 4213, and the essential features of

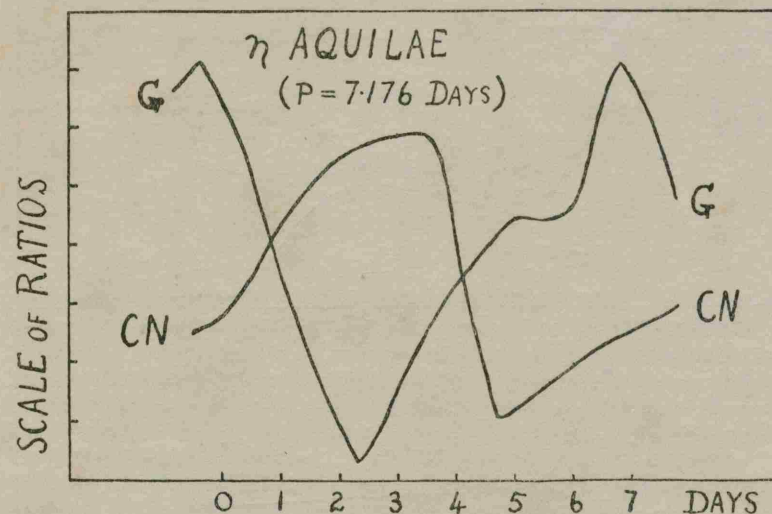


FIG. 2.

the CN curve, namely, its phases at maximum and minimum, are practically unaltered. (λ 4289 is an ultimate line of chromium with arc lines of calcium and titanium closely adjacent; λ 4213 is a very weak line of uncertain origin, possibly due to terbium; λ 4198 is an arc line of iron.)

The significance of the curves in fig. 2 can best be appreciated in conjunction with the physical picture of the pulsating star. For brevity the main facts are set out in tabular form (p. 803), the references to radial velocity being taken from a recent paper by Henroteau.*

5. *RT Aurigæ.*—The period of this variable star is $3^d.724$; its magnitude changes from $5^m.0$ to $5^m.9$; its usual spectral classification is F8 with a range from F1 to G5.†

In fig. 3 four curves are given based upon measurements from the

* *Pub. Dom. Obs.*, ix., 5, pp. 136, 142, 1928.

† Cannon, *Harv. Bul.*, 1930 March 1.

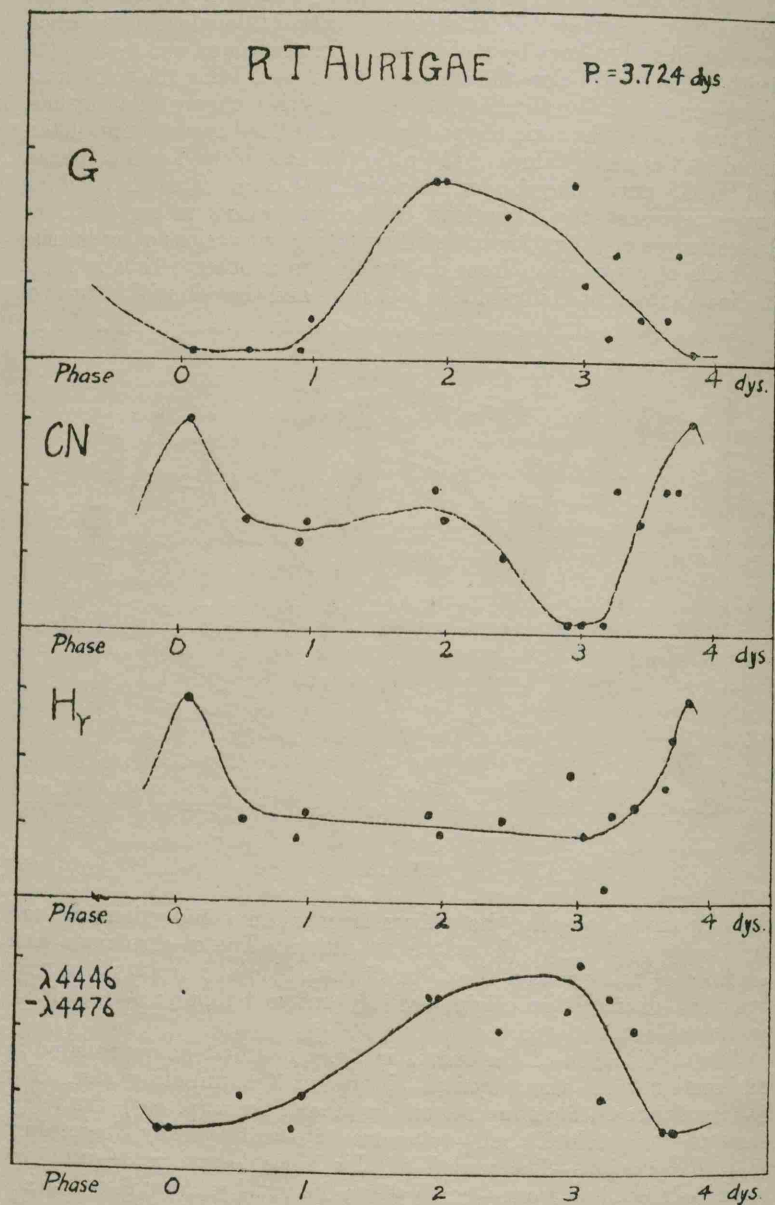


FIG. 3.
(Ordinates represent scales of intensity.)

tracings of fifteen spectrograms. Again the contrast between the G band and the CN band is very striking, as also is the similarity between the behaviour of the hydrogen line $H\gamma$ and CN.

TABLE II.

Phase.	Physical State of Star.	Characteristics of Spectrum.
0 ^d -1 ^d	Minimum radial velocity; most rapid expansion; maximum light.	Ionization strong or rising; CN rising; G falling.
2 ^d -3 ^d	Expanding.	CN rising; G at minimum.
Approx. 3 ^d .5	Maximum volume.	Ionization falling; CN near maximum.
4 ^d -5 ^d	Contracting; minimum light.	Ionization minimum; CN minimum; G strong and rising.
Approx. 6 ^d	Maximum radial velocity; most rapid contraction.	..
Approx. 6 ^d .6	Minimum volume.	G maximum; CN weak but rising.

In order to test how the periodic changes in the intensities of spectral lines would affect a region of the spectrum where the close proximity of strong overlapping lines produces a band-like appearance, measurements were made of the region near $\lambda 4460$, where some thirty strong arc lines are closely assembled. This spurious band behaves much as does the G band, as might be anticipated, and in marked contrast to the CN band and to enhanced lines.

6. *a Ursæ Minoris*.—This star is recognised as a Cepheid variable having a period of 3^d.968; its range in magnitude is very slight, being 0^m.171 as determined photographically, and less visually. Notwithstanding this small range in light, there are appreciable variations in the spectrum.

Fig. 5 is a reproduction of tracings of four spectrograms representing two distinctly different phases. The G band and the CN band are indicated. There is no doubt, as Mr. C. T. Elvey has pointed out, that the better resolution of 3-prism spectrograms greatly reduces the depth of the band, but it does not remove all traces of band absorption, and even if the band does appear somewhat exaggerated on the 1-prism spectrograms, all the measurements being relative, the resulting variations with phase cannot be entirely without value, though lack of standardization of the plates makes certainty obviously impossible.

The G band curve in fig. 4 is based on measurements of ninety-two spectrograms. The CN band was measured relative to $\lambda 4198$ on seventy-seven spectrograms (a), and relative to $\lambda 4213$ on thirty-eight (b). While the two CN curves reflect to some extent the differences in behaviour of these two lines, the main variation represents the changes

in the band and the phases of maximum and minimum are seen to oppose almost exactly those of the G band.

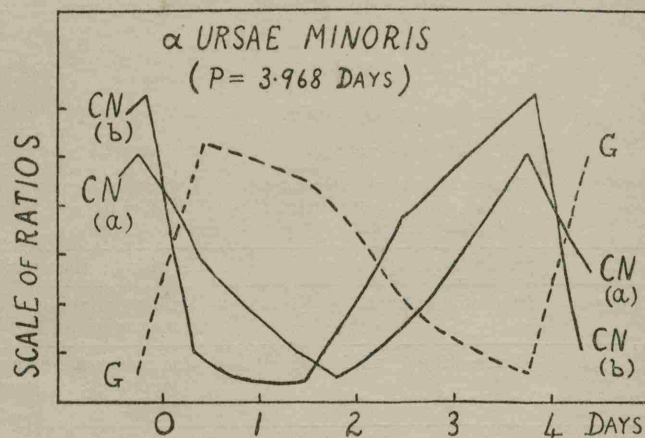


FIG. 4.
(a) Relative to λ 4198.
(b) Relative to λ 4213.

Considering these curves in conjunction with the curves of radial velocity* and light variation, we may tabulate the phenomena as follows:—

TABLE III.
a Ursæ Minoris.

Phase.	Physical State of Star.	Characteristics of Spectrum.
Approx. $0^d.5$	Minimum radial velocity; most rapid expansion; maximum light.	Ionization maximum; CN falling; G maximum.
$0^d.5-1^d.5$	Expanding to maximum volume.	Ionization falling to minimum; CN near minimum; G strong but falling.
Approx. 2^d	Contracting; minimum light.	Ionization weak; CN weak but rising; G strong but falling.
Approx. $3^d.5$	Minimum volume.	Ionization rising; CN rising to maximum; G falling to minimum.

7. The behaviour of cyanogen as indicated by the foregoing results presents a problem of considerable interest.

The resemblance between its behaviour and that of the enhanced lines suggests at once that the molecule is in the ionized state. Two factors would then be working in opposite directions, the increasing

* *Pub. Dom. Obs.*, ix., 1, p. 52, 1925.

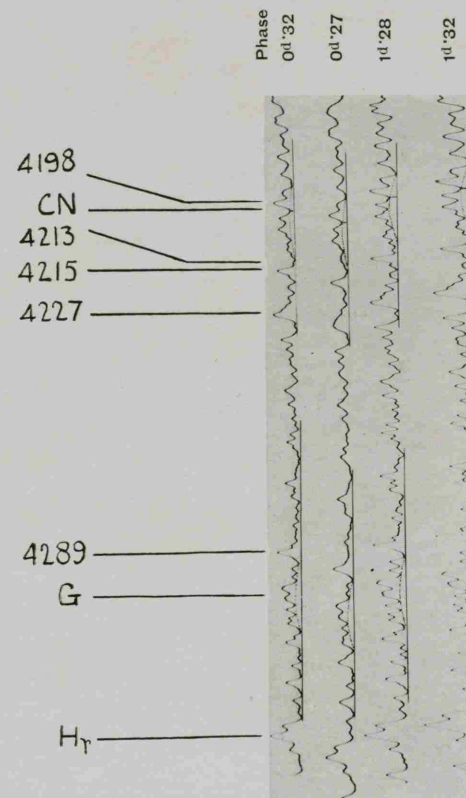


Fig. 5.—Alpha Ursæ Minoris.

temperature bringing about a dissociation of the molecule but producing a larger percentage of ionized molecules among those remaining, while fall in temperature would reverse the two tendencies. No physical data are at present available to disentangle these two effects, but the question is beside the point in any case if the spectroscopists are correct in asserting that the band is undoubtedly due to the neutral molecule.

In the regular sequence of spectral classes the G band reaches its maximum between G and K (according to C. H. Payne), and the CN bands near K₂ (according to Lindblad). As no one of the above stars falls below class G₉, it might be supposed that these two bands would react similarly to the changing physical conditions. The only explanation for the abnormal behaviour of CN that suggests itself at the present time is that, like the enhanced lines of iron, titanium, scandium, and so forth, this band has its origin at a very high level in the stellar atmosphere. Why the CN molecule should be lifted to a higher level than the CH molecule may rest upon the same line of argument as explains the altitude of the ionized calcium atoms in the solar chromosphere, since the CN molecule has strong absorption bands (λ 3883, etc.) near the H and K lines of calcium, whereas the CH molecule, having no strong absorption in this richest region of the continuous emission spectrum, might not be buoyed up to the high levels to which the CN molecule and calcium atoms are carried.

Observations by Shapley and Payne point to the abnormal behaviour of the H and K lines with regard to the periodic changes in spectral class of Cepheids, so that the one explanation may cover the two cases.

Atoms or molecules at high levels in the stellar atmosphere will absorb radiation in accordance with the temperature and pressure existing at that level at any given instant, but there will be a time lag relative to the deeper levels. Increase in interior temperature will precede increase in exterior temperature by a period of time to be measured in days.

This question of time lag plays a fundamental part in the pulsation theory of Cepheid variation, explaining why maximum light coincides with maximum rate of expansion rather than with maximum rate of contraction, this latter being the time when heat is being generated in the interior.

It may well be that consideration of the possibility of different atmospheric levels with consequent time lag provides the key to the problem presented by the apparent anomalies in the behaviour of the cyanogen band and perhaps other features of the spectra of these variable stars.

8. I am indebted to the Director of the Dominion Observatory and to Dr. F. Henroteau for the privilege of examining the spectrograms of that institution, and my thanks are due to them and to all those at the Yerkes, Harvard, and Cambridge Observatories, and at the Imperial College, London, who have at one time or another discussed some aspects of this problem with me.

To Dr. W. M. Smart, Cambridge Observatory, for his generously given assistance and advice, I am especially indebted and very grateful.

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Cosmic Rays: Messages from Space.

By A. Vibert Douglas, Ph.D.

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The study of rays emitted from the depths of space has recently given rise to new ideas about the creation of the universe. The work of Professor Millikan, already noted in "Discovery," is here dealt with in particular, although a solution of the problem has yet to be found.

It is always of special interest to watch the way in which an advance in knowledge in one branch of science may provide the solution of an apparently hopeless problem in another branch. This has happened time and again in astronomy and physics, until to-day their problems are so interwoven that the physicist in his laboratory and the astronomer in his observatory may be in very truth searching for the same thing.

An Astronomer's Problem.

Penetrating radiation is just such a problem—groped after by the astronomer, detected by the physicist, partly understood, and then so amplified by further experiment as to be again a source of great mystification; further discoveries raising it to a position of primary cosmical importance.

When first the astronomer realized that the Andromeda nebula was a spiral aggregation of myriad stars, far out in space beyond the utmost limits of the Milky Way, and estimated its mass to be one thousand million suns, he was mystified by the fact that its total output of light was only one three-thousandth of what was to be expected from so much matter. Why is Andromeda nebula so faint? was the problem to which no answer was immediately forthcoming. And so the astronomer quietly put this problem away upon the shelf of his memory and turned his attention to other matters.

About the year 1902 at McGill University, Montreal, Sir Ernest Rutherford was beginning to feel his way into the innermost recesses of the atom in his early researches in radioactivity. He was led to suspect that anywhere and everywhere on the surface of the earth there could be detected a very penetrating radiation which would pass through a considerable thickness of lead. One of his associates, H. L. Cooke, confirmed this suspicion experimentally, detecting beyond all doubt the influence of this penetrating radiation. Somewhat similar investigations had been carried on independently at Toronto by Dr. J. C. McLennan. Following up this discovery, Dr. A. S. Eve, at McGill University, calculated the intensity

gradient of the penetrating radiation, that is to say, the rate at which its intensity diminished as one ascended above the surface of the earth.

Some time later two continental physicists Kohlhörster and Hess, making use of balloons to attain greater altitudes, discovered that although the penetrating radiation decreased with height until a certain altitude was attained, it then began to increase again. This was of great importance, pointing for the first time to a source of penetrating radiation external to the earth. Thus there were seen to be the two sources—the radioactive elements in the crust of the earth emitting a constant supply of *gamma* rays more penetrating than the hardest known X-rays, and an unknown source outside the earth from which penetrating radiation is poured into our atmosphere continually.

The next step in this tale of discovery was made by Dr. Kohlhörster, when he ascended the Jungfrau and set up his instruments in an ice cave. Here he detected radiation more penetrating than any known *gamma* ray and found furthermore that this cosmic radiation was most intense when the Milky Way was crossing the zenith.

A Physicist's Explanation.

About this time Dr. R. A. Millikan began similar observations in the Rocky Mountains. His results seemed to indicate very little diurnal or seasonal change in intensity. Another series of observations pointed to an increased intensity when the Great Nebula in Andromeda was on the meridian, and no sooner was this announced than the astronomer seized upon it as the explanation of his old problem—why is Andromeda nebula so faint?

The explanation seemed self-evident. The energy which is generated, just how we need not now specify, in a star or in a nebula meets with many vicissitudes on its way out into empty space. In getting to the surface of a star, it encounters millions upon millions of atoms, being absorbed and radiated again, emerging after each encounter slightly longer in wave-length because of the slight loss of energy consequent to each

encounter. Thus, what was originally very penetrating radiation is frittered down to light waves and heat waves by the time it escapes from a star. In escaping from a nebula, however, the density and opacity are so low that a large proportion of the radiant energy leaves the nebula in its original highly penetrating form, and much less of the energy has been reduced to the range of wave-lengths of visible light. Thus the nebula appears faint because a large proportion of its radiant energy is invisible.

One astronomer, basing his judgment upon the results obtained by Kohlhörster, concludes that the source of the cosmic rays is within our Galaxy, emanating probably from the nebulous matter in interstellar space, this diffuse matter being chiefly found near the galactic plane, that is to say, in the Milky Way. Another astronomer, influenced more by Millikan's results, comes to the conclusion that the spiral nebulae are the source, and as they are believed to be fairly uniformly distributed over the entire celestial sphere, this would agree well with the observed constancy of intensity.

The Latest Study.

This is how the problem stood a short time ago, but during the last six months Millikan has published an account of his latest study of cosmic rays and the inferences which he draws from the new facts obtained. In order to understand the line of argument, a word must be said about his method. The intensity of radiation can be measured by the rate of discharge of an electroscope, the penetrating power of the radiation being found by screening off the electroscope and finding how much of the radiation is absorbed by the screen. The more penetrating the radiation the greater the thickness of the screen through which it passes, and the lower will be the "absorption coefficient." Now Millikan used water as his absorbing screen. The absorption caused by the earth's atmosphere is equal to that which would be caused by a water screen ten metres thick. Millikan enclosed his instrument in a watertight case and lowered it beneath the surface of a lake high up in the Rocky Mountains, taking readings down to a depth of 200 feet. Cosmic rays reaching to this depth are of such penetrating power that they would go through 18 feet of lead.

The results were most interesting, indicating that the cosmic rays fall into three distinct groups having different absorption coefficients; for the softest group, 0.35; for the second group, 0.08; and for the most penetrating group of rays, 0.04. What can this signify? Millikan's first conclusion is that

evidently the rays do not come from the annihilation of matter nor from the upbuilding of matter into more complex atoms within a star or nebula, but from the process of atom-building in interstellar space.

Let us consider what are the most common elements in nature and how much energy would be set free as radiation if these elements are being synthesized, atom by atom, from the simplest atom of all—the hydrogen atom—which is composed of one proton and one electron, the two ultimate charges of positive and negative electricity.

Stellar Chemistry.

The hottest stars tell us that they contain a great deal of helium; cooler stars like Capella, Polaris, Arcturus, and our sun tell us of the abundance of iron and silicon in the stellar make-up; yet cooler stars tell of carbon atoms and molecules, while the gaseous nebulae record oxygen and nitrogen until recently unrecognized as such and called nebulium. Apart from this spectroscopic evidence, we have the analyses of many meteorites—54 per cent oxygen, 15 per cent silicon, 13 per cent iron, 13 per cent magnesium; and of the earth's crust (a chance fragment of a quite typical star)—55 per cent oxygen, 16 per cent silicon, 5 per cent aluminium, and lesser percentages of other elements, while the earth's core is undoubtedly chiefly composed of iron.

Now assume that somewhere in space four hydrogen atoms come together, rearranging their protons and electrons into the compact atom called a helium atom. The relative weights of a hydrogen and a helium atom are 1.00778 and 4.0, whereas one would expect the helium atom to weigh 4×1.00778 or 4.03112, since it contains four protons and four electrons while the hydrogen atom has only one of each. Where has the extra mass gone? Evidently the closer packing of the electric charges in the nucleus of the helium atom results in less energy content or mass, so that the excess energy represented by the figure 0.03112 is dissipated into space as radiation. It is always possible to evaluate the mass of a body as ergs of energy and to calculate the frequency of the radiation to which this energy would give rise, by means of a relation due to Einstein and to Planck:—

$$mc^2 = E = h\nu$$

where m is the mass expressed in grams, c is the velocity of light, E the energy in ergs, ν the frequency of the radiation and h a numerical factor known as Planck's constant. Knowing thus the frequency and therefore the wave-length of the radiation, it is possible to calculate its absorption coefficient by means of a somewhat complicate formula due to Dirac.

Millikan carries out these calculations and finds that the synthesis of helium from hydrogen would be accompanied by an emission of a radiation having an absorption coefficient 0.30 in very fair agreement with his experimental value, 0.35. Encouraged by this, he passes on to consider the synthesis of an oxygen atom and a nitrogen atom from 16 hydrogen atoms and from 14 hydrogen atoms respectively. The one process leads to a cosmic ray with absorption coefficient 0.074, the other to 0.086 or averaging the two, 0.080 as found experimentally. Carbon, another of the abundant elements being equivalent to 12 hydrogen atoms, would give rise to a radiation falling alongside of the oxygen-nitrogen group.

It takes 28 hydrogen atoms to build one silicon atom, and here again the absorption coefficient of the resulting radiation agrees closely with the experimental value—0.041 and 0.040. Not very different would be the radiation accompanying the synthesis of each magnesium atom from 24 hydrogens.

But what of iron, perhaps the most abundant of all the elements? If 56 hydrogen atoms unite suddenly to form one iron atom, a radiation would be emitted even more penetrating. This radiation, however, has not been detected. Nevertheless, one cannot but be impressed by the close agreement between theory and observation in the other cases.

Eddington's View.

It should not be supposed that this is the first time that synthesis of the atoms of other elements from the hydrogen atoms has been suggested as a source of radiant energy—far from it. As soon as relative atomic weights were accurately established and the relation between mass and energy known, this hypothesis arose quite naturally, but following the lead of Professor Eddington most people looked to the interior regions of the giant stars as the places where this upbuilding was taking place. The stars became in our thoughts the crucibles of nature in which the successively heavier atoms were being evolved, as in a fiery furnace of Nebuchadnezzar seven times heated. Not but that this picture had its attendant difficulties. The centre of a great star may be at a temperature of twenty million degrees or more, but is that hot enough? Professor Eddington's famous reply to such critics is well known, being briefly a courteous invitation to "go and find a hotter place."*

Professor Millikan declines that invitation and says, in effect, that it is not a hotter but a colder place that is needed. It is in the regions of lowest material density and most nearly at the absolute zero of temperature

* See "Stars and Atoms" (Clarendon Press), 1927, p. 102.

where the hydrogen atoms are so quiescent that their kinetic energy is almost reduced to nothing—it is there that the synthesis of the elements will occur.

Which of these two views is correct? It is well, perhaps, to reserve our judgment until further and more convincing evidence is forthcoming. The latter hypothesis like the former has its difficulties which we must not ignore. Imagine all the matter in a great galaxy of a thousand million stars suddenly ceasing to exist as matter, its equivalent energy being all of the form of radiation traversing and retraversing without loss the same vast volume of space as the galaxy had occupied. Then in every 400 cubic feet there would be just enough radiant energy to form one hydrogen atom if it could all be concentrated into the material form of one proton and one electron. Imagining this miracle to have been accomplished, our galactic volume is now filled with hydrogen atoms, the density being one atom to each 400 cubic feet. Next picture the chance coming together of four of these atoms to combine as a helium atom, or 16 of them to form an oxygen atom, or 56 of them to form an iron atom, and so on. It is not an easy flight of the imagination, nor is it rendered less difficult by assuming it to take place very gradually during aeons of time.

A further criticism comes from Queen's University, Canada, where Dr. J. A. Gray claims that Millikan overlooks the effects of the secondary or scattered radiations in calculating the wave-lengths, which are actually shorter than those derived by Millikan.

The problem of the source of the penetrating radiation is thus not yet solved, but it has brought us face to face with alternative theories of atom building and of the annihilation of matter, the transformation of the energy of matter to the energy of radiation, and *vice versa*.

A Philosopher's Answer.

Possibly it is not too much to hope that the further study of the cosmic rays may yet throw light upon the vast cosmical processes. Are they indeed irreversible, or is Millikan right in regarding them as reversible? Most physicists would give the affirmative answer to the former question. Perhaps the reader, turning disappointed from this ebb-tide picture of the universe, will find comfort in the words of the philosopher, Dr. A. N. Whitehead, who states his belief in a universe "physically wasting," it is true, but "spiritually ascending" whatever that may mean to him, to you, or to me. *Quot homines tot sententiae*.

The Corona by Reflection from the Moon

THE light from the photosphere of the sun will illuminate not only the hemisphere of the moon facing the sun but also a zone five miles wide beyond the great circle bounding the hemisphere. A further zone five miles in width will be illuminated by those radiations emanating from the corona, if the height of the corona be regarded as equal to one radius of the sun. The intenser light of the relatively low inner corona will fall on a narrow strip of this lunar zone, bordering upon the edge of the surface upon which the photospheric light is falling.

Let the slit of a spectrograph be placed across the illuminated portion of the moon's surface so that half the slit is projecting over the apparently unilluminated lunar surface. It will thus cross this five mile zone, which will be reflecting corona light. The spectrogram should reveal first a strip of the usual reflected sunlight; then, theoretically, the emission lines of the high chromosphere; and then the typical corona spectrum.

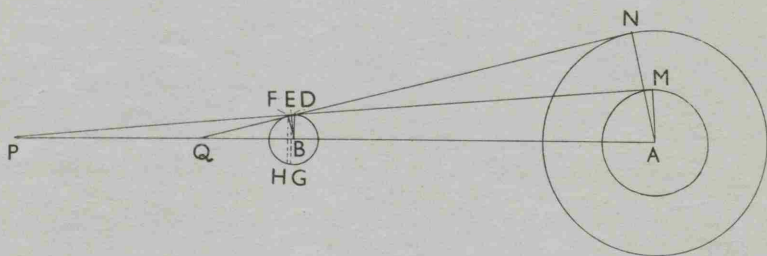


Fig. 1.

The practical difficulties involved are the very long exposure times which would be required to gather sufficient reflected corona light to give the image, and the very exacting requirements of guiding.

If one of the powerful long-focus telescopes were used for this investigation, and a 15-inch image of the moon were formed at the plane of the slit, then a five-mile strip of the moon's surface would be 0.95 mm. at the slit. Hence the need for very accurate guiding is obvious, so that the edge of photospheric illumination will not encroach upon this critical millimetre of the slit.

Since earthshine is strongest upon the moon during its early phase, this would not be a good time, but at and near half moon would seem to be the most favourable period.

In Fig. 1, AM is the radius of the sun; MN indicates the region of the corona; B is the moon;

PEM is tangent to both moon and sun, and *QFN* is tangent to moon and corona. Thus *EG* bounds the photospherically illuminated portion of the moon, while *EG* and *HF* define the zone illuminated only by coronal light. Obviously this narrow strip of the moon's surface presents the largest target as viewed from the earth at first and third quarter.

The director of Mount Wilson Observatory has expressed his interest in this proposed method of investigating the corona, and suggests the desirability of having the method tried out at more than one observatory.

A. VIBERT DOUGLAS.

McGill University,
Montreal.
May 11.

COPERNICUS 1473-1543*

BY A. VIBERT DOUGLAS

Kingston Centre, R.A.S.C.

The life span of Copernicus covers a period in history filled with movement in many spheres of human endeavour. It was an age of intolerance and reaction on the one hand and of high adventure and daring on the other.

These were the years when Michelangelo was at work in the realm of art; when Martin Luther was breaking with traditional theology and fighting for freedom of thought and conscience in the realm of religion; when Paracelsus was vitalizing mediæval medicine and Vesalius was making of anatomy a modern science; when the Moors with their rich Arabic learning were being pushed out of Spain, while Italy, the main centre of European scholarship, was gradually awakening from an intermittent sleep of twelve centuries. In these years when Christopher Columbus was sailing uncharted seas to discover the islands of a new continent, Copernicus was turning his back upon the ancient cosmologies to give the world the heliocentric model of the Universe.

In the thirteenth century the Teutonic Knights had founded the town of Torun or Thorn on the broad, navigable Vistula. This became an important trading port of the Hanseatic League. From Cracow, the chief town of Poland, a prosperous merchant named Niklas Koppernigk moved to Torun, married the daughter of a Polish-German merchant of that town, and on Feb. 19, 1473 their fourth child, Niklas, was born. This boy grew up to become one of the makers of modern thought. When he reached the stage of productive scholarship, he followed the custom of the scholars of his day by publishing his works in Latin, and like so many of them he Latinized his name as author. Thus we know him not as Niklas Koppernigk, but as Copernicus.

*This article is based on a paper which appeared in the Queen's Quarterly, vol. L, no. 2, 1943 commemorating the 400th anniversary of his death.

The education of Copernicus was long and varied. From the school of Torun he went to the University of Cracow in 1491. Here he found a strong school of mathematics and astronomy and no doubt studied the only two cosmologies that had survived the centuries since the rich speculative and mathematical period of Greek science. The simple Aristotelian system was based upon the geocentric universe of Pythagoras. The more complicated Ptolemaic system was built upon the ingenious work of the great Greek geometers who used circles and epicycles to reproduce the apparent motions of sun, moon and planets. While the Earth was not placed at the centre of these circles, it was still within the circles of all the heavenly bodies, and thus sun, moon, planets and stars moved around it.

In 1496 Copernicus went to Bologna where he worked at the school of law for four years. Here too he found astronomical interests in the observations and theories of the professor of astronomy, a brilliant man with an independent, critical mind, a leader in the current revival of Platonism. To the left of the great bronze doors to the Assembly Hall is a plaque to Dante Alegheri, Scholar in Bologna, 1287, and on the right a plaque to "Copernicus of Poland glorious son of this institution", erected in 1836.

Copernicus next went to Rome where he took private pupils in Mathematics, but a year later he resumed his legal studies at Padua. Here he also studied Greek and began his wide reading in Greek science which led to his discovering for himself the half-forgotten speculations of Heraclides, Ecphantus and Hicetas on the axial rotation of the earth, and the heliocentric system of Aristarchus of Samos. This last was indeed a forerunner of the great scientific life-work of Copernicus, but it had been backed up in the third century B.C. by not one logical argument based upon astronomical observation which could overthrow the amazing partial success of the elaborate systems built upon the epicycles of Eudoxus.

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For six years after taking up his residence as a Canon of Frauenburg, Copernicus served as medical attendant upon his uncle at the Bishop's palace which was the castle of Heilsburg. Here he was able to devote time to astronomical pursuits as well as to exercise the art of healing amongst the

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In the years 1523-32 Copernicus revised the manuscript of his great book, but apparently he made no attempt to publish it. It was known to exist, however, but only a very few scholars had the vision and the courage to be openly interested. In 1536 Cardinal Schönberg of Capua wrote to Copernicus as follows:

Having constantly heard of your talent, I have begun to honour you more fully, and to congratulate our countrymen amongst whom you have flourished with so great renown. For I had perceived that you were not only well versed in the works of the old mathematicians, but also had propounded a new theory of the universe. By it you teach that the earth moves, that the sun is at the bottom of the universe, and indeed holds the middle place. That the eighth heaven remains immovable and eternally fixed. That the moon, with the elements included in her sphere, placed between the heaven of Mars and Venus, revolves in a yearly course round the sun. And that you have written commentaries on this whole theory of astronomy, and have reduced into tables the motions of the planets, computed from calculations, to the great admiration of everyone. Wherefore I beseech you, most learned man, if I am not troubling you, to impart this your discovery to the learned, and also to send to me in the first place your lucubrations concerning the sphere of the universe, with the tables, and anything else you have pertaining to the same matter. And if you will gratify me in this, you will find that you have to do with a man careful of your name, and one anxious to do justice to such great talent. Farewell. At Rome, Calends of November, 1536.

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Four hundred and thirty years ago the words of Osiander supplied a temporary and partial camouflage for the dynamite which the book contained. Copernicus had written,

First and above all lies the sphere of the fixed stars, containing itself and all things, for that very reason immovable; in truth the frame of the universe, to which the motion and position of all other stars are referred. Though some men think it to move in some way, we assign another reason why it appears to do so in our theory of the movement of the earth. Of the moving bodies first comes Saturn, who completes his circuit in xxx years. After him, Jupiter, moving in a twelve year revolution. Then Mars, who revolves biennially. Fourth in order an annual cycle takes place, in which we have said is contained the earth, with the lunar orbit as an epicycle. In the fifth place Venus is carried round in nine months. Then Mercury holds the sixth place, circulating in the space of eighty days. In the midst of all dwells the Sun. Who indeed in this most beautiful temple would place the torch in any other or better place than one whence it can illuminate the whole at the same time? Not ineptly, some call it the lamp of the universe, others its mind, others again its ruler – Trismegistus, the visible God, Sophocles’ Electra, the contemplation of all things. And thus rightly in as much as the Sun, sitting on a royal throne governs the circumambient family of stars ... We find, therefore, under this orderly arrangement, a wonderful symmetry in the universe, and a definite relation of harmony in the motion and magnitude of the orbs, of a kind which it is not possible to obtain in any other way. (*De Revolutionibus*, Bk. I, Chap. X.)

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Small wonder, then, that when the far-reaching significance of this book was realized, timid, bigoted and intolerant ecclesiastics denied its implications and discouraged the study and discussion of its arguments by threat of torture and the stake. It was not, however, placed upon the Index until 1616, but there it remained until 1835.

William Gilbert in England and Giordano Bruno in Italy, both born in the 1540's, became the first notable men outside central Europe to convince themselves that a new light had dawned in astronomical thinking, and a new universe lay open to the eyes and minds of men. Gilbert advocated the Copernican theory and lived to publish his famous *De Magnete* and to die in 1603 respected and honoured in Elizabethan England. But Bruno's advocacy of the same theory placed his life in jeopardy. He escaped from Italy and proceeded to expound the Copernican cosmology and his own somewhat pantheistic but rather beautiful philosophy in Geneva but fled the intolerant disapproval of Calvinism. In Paris and later in Oxford and in Wittenberg he discoursed upon the new theory, being generally opposed but arousing interest in it wherever he went. Lured back to Italy on a promise of freedom to think and teach what he believed true, this scholarly disciple of Copernicus in science and of von Cues and Ramón Lull in philosophy went to the stake in Rome in 1600 for his advocacy of new ideas.

Sixty-seven years after the death of Copernicus Galileo placed the Copernican Theory on so firm a footing of new astronomical observations that his name stands linked with those of Copernicus before him and Sir Isaac Newton following him at this great turning point in the history of human thought.

Thus Copernicus and his book ushered in the renaissance of learning in astronomical science. During the centuries which have followed, knowledge has grown from more to more. Copernicus had displaced the Earth from the centre of the Universe and man's abode had become a minor planet. In a later century the Sun and planets were removed from a central position in the stellar universe to an inconspicuous place more than half way out along a radius of the Milky Way system. In our own century our galactic system has become only one of many million stellar galaxies. Circles gave place to Kepler's elliptic orbits three centuries ago. Nothing now remains static, neither earth nor sun nor stellar galaxy, not even the framework of space itself in the Lemaîtreian speculations of an expanding universe.

The repercussions of the Copernican cosmology upon philosophy were inevitably far reaching, though Copernicus himself seems not to have realized the full implications of his work in this respect. His great successor, Galileo, boldly drew the inferences – if a geocentric cosmology had to be abandoned, anthropocentric philosophy must likewise go. Henceforth the man of science must investigate nature with complete objectivity. Philosophy

must break away from the shackles of teleology focused upon man. Man was no longer obviously of prime importance as had been so easy to assert in the ancient world with its geocentric outlook. For man the sun and moon rose and set, for him the stars shone forth, for him the rains fell and the earth produced her increase – “Thou madest him to have dominion over the works of Thy hands, Thou hast put all things under his feet”. If today man be regarded as of great intrinsic worth, it is not because this is an inevitable deduction from a survey of the physical universe, it must be for intellectual and spiritual reasons. Such reasons, happily, are not wanting when we study the character, achievements and influence of such men as Copernicus, men filled with courage and with “the divine afflatus of the truth-seeker”.

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*Corrected
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COPERNICUS

1473 - 1543

BY A. VIBERT DOUGLAS

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THE life span of Copernicus covers a period in history filled with movement in many spheres of human endeavour. It was an age of intolerance and reaction on the one hand and of high adventure and daring on the other.

It was the time when Michelangelo was at work in the realm of art; when Martin Luther was breaking with traditional theology and fighting for freedom of thought and conscience in the realm of religion; when Paracelsus was vitalizing mediæval medicine and Vesalius was making of anatomy a modern science. It was the time when the Moors with their rich Arabic learning were being pushed out of Spain, while Italy, the main centre of European scholarship, was gradually awakening from an intermittent sleep of twelve centuries. It was the time when Christopher Columbus was sailing uncharted seas to discover the islands of a new continent. It was at this time that Copernicus turned his back upon the ancient cosmologies and gave the world the heliocentric model of the Universe.

In the thirteenth century the Teutonic Knights had founded the town of Torun or Thorn near the mouth of the Vistula. This became an important trading port of the Hanseatic League. From Cracow, the chief town of Poland, a prosperous merchant named Niklas Koppernigk moved to Torun, married the daughter of a Polish-German merchant of that town, and in 1473 their fourth child, Niklas, was born. This boy grew up to become one of the makers of modern thought. When he reached the stage of productive scholarship, he followed the custom of the scholars of his day by publishing his works in Latin, and like so many of them he Latinized his name as author. Thus we know him not as Niklas Koppernigk, but as Copernicus.

COPERNICUS, 1473-1543

The education of Copernicus was long and varied. From the school of Torun he went to the University of Cracow in 1491. Here he found a strong school of mathematics and astronomy and no doubt studied the only two cosmologies that had survived the centuries since the rich speculative and mathematical period of Greek science. The simple Aristotelian system was based upon the geocentric universe of Pythagoras. The more complicated Ptolemaic system was built upon the ingenious work of the great Greek geometers who used circles and epicycles to reproduce the apparent motions of sun, moon and planets. While the Earth was not placed at the centre of these circles, it was still within the circles of all the heavenly bodies, and thus sun, moon, planets and stars moved around it.

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THE CHEMISTRY OF THE STARS

BY

A. VIBERT DOUGLAS, PH.D.

(Reprinted from DISCOVERY, OCTOBER, 1928)

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The Chemistry of the Stars

By A. Vibert Douglas, Ph.D.

Macdonald Physics Laboratory, McGill University, Montreal

New facts discovered about the chemistry of the stars have altered former ideas, and the whole question of stellar evolution is at present under reconsideration. Theories which seemed tenable two or three years ago are either abandoned or regarded with caution.

THE chemistry of the stars is fortunately not very complex. By far the greater proportion of the matter in the universe is at tremendously high temperatures. According to a recent estimate, ninety per cent of all matter is at a temperature exceeding $1,000,000^{\circ}$ centigrade. Here the physical conditions are comparatively simple and molecules are unknown, for the atoms themselves are disrupted into free electrons, protons, and atomic nuclei, all moving about with tremendous velocities in a medium literally filled to bursting-point with penetrating radiation. This is the picture of the interior of a star.

At more moderate temperatures, perhaps $20,000^{\circ}$, most of the atomic nuclei have captured a sufficient number of electrons almost to balance their positive electrostatic charges, while at somewhat lower temperatures most of the atoms are fully equipped with their requisite numbers of orbital electrons and at about $12,000^{\circ}$ the linking together of atoms to form simple molecules commences. Down even to the temperature of $3,000^{\circ}$, however, the tendency to aggregate into molecules is not very marked, and only about a dozen chemical compounds are recognized. This is the state of affairs in the atmospheres of the stars.

Thus it is evident that the chemical conditions which we have on the earth are not representative of the universe as a whole. The perhaps not unique but certainly very exceptional conditions of temperature and pressure on the earth have favoured the synthesis of complex

inorganic and yet more complex organic compounds, but these diverse forms of matter are not typical of the universe.

How is the chemistry of the stars studied? Obviously it must be learned from the only thing the star sends to us, namely, electro-magnetic energy. The secrets of its nature are imprinted in the starlight. It thus becomes a question of spectroscopy—the analysis of the starlight and the decodifying of the message. Sir Isaac Newton laid the foundation stone when he investigated the prismatic refraction of light in 1672. Fraunhofer first carefully observed the many dark lines in the spectrum of sunlight, Kirchhoff first explained them. The cooler atoms in the outer atmosphere of sun or star are absorbing just those radiations which they would themselves emit if they were at a sufficiently high temperature to radiate, hence it is possible, by matching up absorption lines occurring in a stellar

spectrum with well-known emission lines produced in a laboratory by raising known elements to incandescence, to identify the elements in the stellar atmosphere. This was done by Sir William Huggins, Sir Norman Lockyer, Father Secchi, and other pioneer astrophysicists.

Stellar spectra are now photographed at most of the leading observatories. Either the starlight passes first through the telescope and then through the prisms to the photographic plate (see Figs. 1 and 2), or else the prism is placed in front of the objective glass of the telescope, and then the light passing on through the

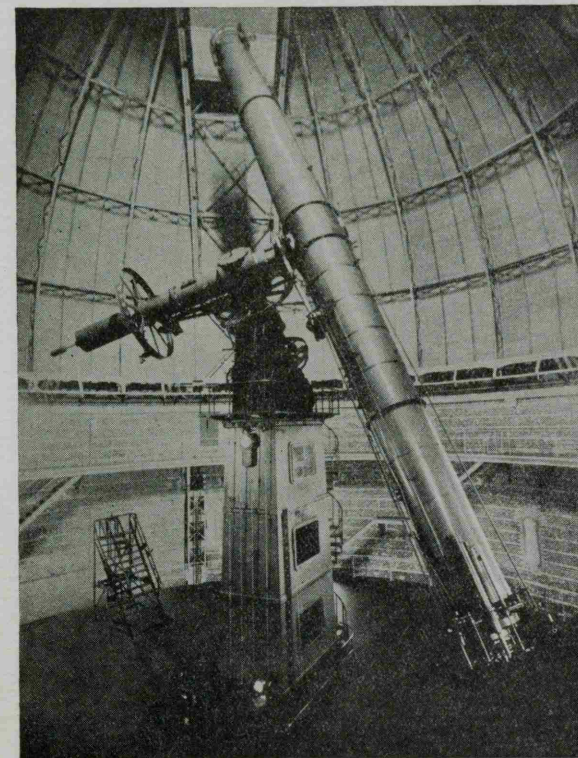


FIG. 1.

FORTY-INCH REFRACTOR.

This giant telescope of Yerkes Observatory, whose lens is 40 inches in diameter, is 62 feet in length and weighs, with its counterbalancing weights and all the moving parts, about 20 tons. The dome is 90 feet in diameter.

Photograph by Prof. F. E. Ross, Yerkes Observatory.

telescope falls on the photographic plate. In the former case one star at a time is photographed, in the latter arrangement all the stars in the field of view impress their spectra on the plate simultaneously.

Careful study of stellar spectra shows that there are many different types, but that they grade imperceptibly one type into the next. They were classified at Harvard Observatory in a sequence of increasing complexity of appearance, but subsequently it was realized that an order was possible which represented the changes resulting from gradually decreasing temperature. The main portion of this sequence is shown in Fig. 4.

Of the ninety-two elements recognized by modern atomic physics only two remain unidentified by chemical or by spectroscopic analysis of terrestrial matter. The elements not as yet detected in the stellar spectra are sixteen in number, namely: boron, fluorine, neon, phosphorus, chlorine, argon, arsenic, selenium, bromine, krypton, antimony, tellurium, iodine, xenon, gold, and radon. In addition to these there is considerable uncertainty with regard to some of the elements known as the rare earths and the following other elements: beryllium, germanium, indium, tantalum, tungsten, osmium, iridium, platinum, mercury, thallium, bismuth, thorium, uranium.

It should be remembered, however, that because the lines typical of these elements are not definitely identified in the stellar spectra, we need not draw the conclusion that these elements are absent. Various factors might enter into the question—the conditions required to excite the radiations or absorptions might not be exactly those of the stellar atmospheres, or the typical lines might fall in a region of the spectrum not obtainable, that is, too far in the infra-red or too far in the ultra-violet to be photographed. The amazing thing is not that so many elements are unidentified, but that so many are known beyond any shadow of doubt to be present in the stars.

The spectra of the hottest stars reveal the presence of hydrogen and helium and many ionized atoms of

various elements, that is, atoms with an excess positive charge owing to the fact that not all the required electrons have been captured by the nuclei. An atom lacking one electron is said to be once ionized, if two are missing it is doubly or twice ionized and so on. In these hottest stars are ionized oxygen, nitrogen, carbon, silicon, calcium, magnesium, and the first four of these also appear in the twice ionized state.

As we pass to somewhat cooler stars some of the ionized lines fade out while others appear and also many lines due to neutral atoms—iron, titanium, strontium, barium, vanadium, aluminium, etc. It is at this stage, in the Class A stars, that molecular structure first puts its impress on the spectra. A molecule radiating or absorbing light does not do so as distinct lines, but as one or more bands. Thus a whole region of the spectrum will be affected if molecules are absorbing light in the star's atmosphere, and a dark patch or band is produced, usually sharply defined at one extremity and gradually fading off at the other. This is best seen in the K and M stars in Fig. 4. In the A stars band structure is first seen and is due to the carbon nitrogen compound cyanogen.

A striking feature of a yet cooler spectrum, the solar type of Class G, is a narrow band at wave-length λ 4314, known as Fraunhofer's G-band, identified by Newall, Baxandall, and Butler with some hydrocarbon molecule. Stars cooler than type G whose spectra are chiefly distinguished by the bands of cyanogen, carbon monoxide and hydrocarbon, are classified R and N according to the development of these bands.

The majority of the stars cooler than Class G stars, however, are not of Classes R and N, but belong to what is known as the *main sequence* which terminates with Classes K and M. Their spectra are free from the bands of carbon compounds, but in the M stars the bands of titanium oxide are the dominant characteristic. No star is known whose spectrum shows both carbon compounds and titanium compounds, these two seem



FIG. 2.

THE BRUCE SPECTROGRAPH AT YERKES.

The spectrograph is attached to the lower end of the great Yerkes telescope. The light from the star, focussed by the telescope on the slit of the spectrograph, is made to pass through one, two or three prisms before falling on the photographic plate. To ensure steady conditions the spectrograph is enclosed in the constant temperature case seen at the right of the photograph.

From a Yerkes Observatory photograph.

to be mutually exclusive. A small class of the cooler stars, very analogous to the M stars, are designated as Class S. Zirconium oxide bands are present in their spectra. Occasionally, but not always, titanium oxide is also present, but the zirconium oxide molecule appears to persist to higher temperatures than the former molecule can stand. Fig. 3 illustrates the sequence of stellar types above mentioned, though one cannot attempt to read into the diagram a simple evolutionary scheme. The whole question of stellar evolution is at present under reconsideration. New facts have altered old ideas. Theories which seemed tenable two or three years ago are either abandoned or regarded with cautious suspicion.

The spectrum of sunspots presents an interesting field of study, for their conditions are not typical of the undisturbed solar surface. Vast vortices of rising gas suddenly reach a level of lower pressure in the higher portion of the sun's atmosphere and, rapidly expanding, the gases cool down producing absorption spectra more nearly resembling that of stars of Class K. Sunspot spectra reveal the presence of water vapour and magnesium and calcium hydride. Bands of ozone and water vapour do appear in the spectra of stars, but can be shown to be of telluric origin, that is to say, to be effects produced in the spectrum as a result of the passage of the light through the earth's atmosphere. If these bands were strengthened in the spectra of sunspots and the cooler stars, this would be evidence of the presence of these compounds at the source. This is so with the water vapour, but not with the ozone. Theoretically, ozone might be expected in the atmospheres of M stars, for Fowler and Strutt calculated its maximum thermal formation to be at a temperature of 3,500° centigrade at a pressure 10^{-7} atmospheres, conditions probably existing in the outer portions of the M stars.

In the ultra-violet spectrum of sunlight the bands due to ammonia have been identified by Fowler and Gregory.

The spectra of the planets are, of course, due to reflected sunlight, but they show certain absorption bands not present in direct sunlight and therefore due to the planetary atmospheres. In the case of Venus and Mars the effect is almost negligible, but Jupiter, Saturn, Uranus and Neptune certainly have atmospheres differing somewhat from that surrounding the earth. Unfortun-

ately the bands in their spectra are of unknown origin as yet. Chlorophyll may be responsible for some of the bands, but the evidence is inconclusive.

The spectra of comets exhibit many features of interest. There are several bands as yet unidentified, while other conspicuous bands are due to carbon monoxide, cyanogen, and the hydrocarbons, possibly acetylene and methylene. The elements responsible for the line spectra are hydrogen, helium, sodium, and iron. Meteors are generally supposed to be typical of the material composing the head of a comet. This seemed definitely proved in the case of Biela's Comet, which returned once or twice showing signs of disruption and then was seen no more, but in its place at the appointed time there came a meteoric shower of considerable brilliance. The analysis of meteorites is therefore of

significance—iron, nickel, calcium, silicon, gallium, rubidium and magnesium.

In the nebulae, the spectroscopist has found hydrogen, helium, carbon, nitrogen, and several strong broad lines usually referred to as "nebulium" lines. Many speculation have been made regarding these. In the autumn of 1927, Dr. Bowen of Cali-

fornia, calculated how much energy would be emitted by certain unusual electron movements in atoms of ionized or doubly ionized nitrogen and oxygen, and found very good agreement with many of the nebular lines. In support of this explanation of the nebular lines Professor A. Fowler added further evidence, but the question remained:—If oxygen and nitrogen produce these lines, why do we not also find in the spectrum the lines most frequently associated with these ions?

An answer to this was given by Professor Eddington in December last. He drew attention to the change in the relative intensities of probable and improbable emission lines when the stimulating radiation is exceedingly weak, and the density of the gases of the nebula so low that once an atom has become ionized it will wander far and wide before encountering a free electron which it can capture to complete its full quota. The picture we form, therefore, of a gaseous nebula is this: a vast expanse of space (so vast, indeed, that our whole solar system would be but an insignificant portion), filled with about as much gas—hydrogen, helium, oxygen, nitrogen, carbon compounds and so forth—as would altogether make up a mass equivalent to our sun. This tenuous gas is not at a very high temperature, but

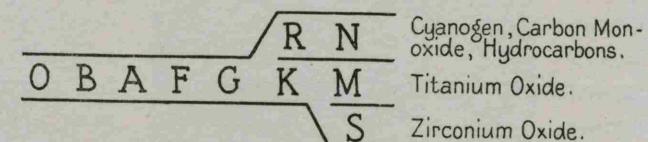


FIG. 3.

MAIN SEQUENCE OF STELLAR SPECTRA AND BRANCHES.

This diagram illustrates the sequence of stellar types, as exemplified by their spectra, though one cannot attempt to read into it a simple evolutionary scheme.

is being traversed by the light from nearby stars. Much of this light is absorbed by these tenuous gases and then re-emitted in the manner distinctive of the nebular conditions.

The chief debt of the astrophysicist to the chemist is in the development of ionization theory. The physical chemist has elaborated the theory of dissociative equilibrium. Saha, a distinguished Indian astrophysicist, realized that there was a logical analogy between this problem and the problem of ionization in a star's atmosphere. We know that electron bombardment upon a gas, or the passage of X-rays or other penetrating radiation, will disrupt some of the atoms of the gas, thus producing ionization. But ionization can come about in the absence of these agents. This *natural ionization* occurs spontaneously, the energy needed to expel the electron from the atom being drawn from the environment, which thus becomes cooler. This has proved to be a very fruitful line of investigation, but space will not permit of its discussion in this article.

Chemists, for the most part, think in terms of molecules. Biochemists, in particular, are wont to think of some very large molecules. Hæmoglobin, for example, the red corpuscle in the blood, is a molecule of sufficient size and complexity to appal the average mind, for it is said to comprise about 100 carbon atoms, 200 hydrogen atoms, as well as many atoms of iron and other elements. Let not the chemist, however, boast of his giant molecules, for if it came to a contest

as to who could think of the largest molecule, it would not be the chemist who would carry off the palm of victory. The astrophysicist would stand *facile princeps*.

There is a class of stars, of which the companion of Sirius is the best known example, called the white dwarfs. Hidden from view beneath the atmosphere of such a star, so much matter is packed so closely together that its density is about 50,000 gms. per c.c., or, in other words, one ton of matter is packed into every cubic inch of space inside the star. Observation and calculation point to this tremendous density and spectroscopic results confirm it, but can one explain it?

The explanation took this form. When we think of the compression of any substance, we picture the limiting density as being attained when the atoms or molecules have been pressed shoulder to shoulder, as it were.

Greater density is only possible if each atom can itself be reduced in size. Now the effective volume of an atom is determined by the radius of the orbit around which whirls its outermost electron. The volume of the atom cannot be greatly reduced by compelling the electrons to move in nearer and nearer to the nucleus, but the volume can be reduced, and reduced many thousand-fold, by removing the electrons altogether, that is to say, by completely ionizing the atoms. Our substance is then reduced to a gas made up of myriad electrons each having a diameter of only 0.000000000001 cm. and each moving with incredible rapidity unconstrained to any orbit, and of the atomic nuclei which, though they be over a thousand times more massive than the electrons, are a thousand times smaller in diameter. Such a gas may be compressed to densities far exceeding that above mentioned. This is apparently what has happened in these white dwarf stars, and in order to maintain their complete or almost complete ionization it is calculated that the temperature within the star must be almost incredibly high—of the order of 100,000,000° centigrade.

Just here a grave difficulty arose. The old physics teaches that the higher the temperature of a mass of matter the more intense will be the outflow of radiant energy from it. Thus our hot dense star, which to grow denser must grow hotter at its centre, ought to be radiating more and more fiercely as it grows older. But its total energy is finite, and hence the apparent contra-

dition that the time will come when its store of energy is almost exhausted, it will want to cool down, but will not have retained sufficient energy to expand or lift its outer layers against gravity. Such a perplexing situation can never arise in the natural world—it must be our physics that has led us astray.

We of this generation have seen the birth of the new physics, and though few as yet have grasped its full significance and mastered its principles, all may gain some idea of its line of thought and gaze with wonder and admiration at what the new methods have already achieved.

The new methods of physics have been applied by Mr. R. H. Fowler of Cambridge to this problem, with results which may be stated somewhat thus:—There are two definitions of temperature. One states that the

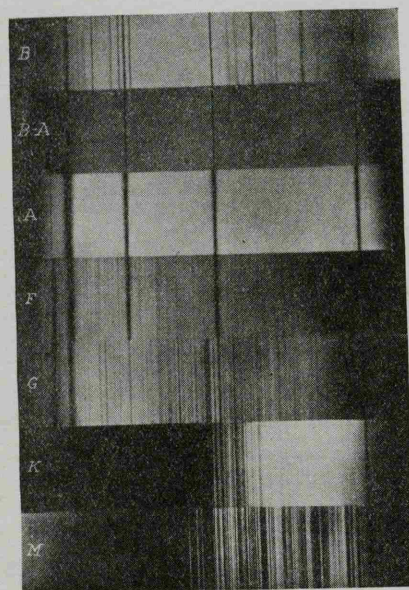


FIG. 4.

TYPICAL STELLAR SPECTRA.

Well-known stars whose spectra exhibit these typical features are the following: Early B— ϵ Orionis (Anilam); Later B— β Orionis (Rigel); A— α Canis Majoris (Sirius); F— α Canis Minoris (Procyon); G— α Aurigae (Capella); K— α Bootis (Arcturus); M— α Orionis (Betelgeuse).

Photograph by Harvard College Observatory.

faster the motions of the atoms or molecules, the higher is the temperature, and *vice versa*; in other words, temperature is a measure of the average speed of the particles. The other definition states that temperature is a measure of the ability of a body to radiate. Under terrestrial conditions these two definitions agree perfectly and the old physics regarded them as synonymous; but the new physics shows that we cannot generalize and deduce that under all extreme conditions these two definitions will agree. Indeed, they begin to diverge very greatly when very dense matter is being considered. In our dense star the velocities of the free electrons and atomic nuclei are approaching the highest velocity possible, and hence one definition says that this is the hottest matter in the universe. But this very density means that any one particle has no choice as to where it will go next. There is possible but one place and one speed for each particle at any instant. Radiation depends upon there being freedom of motion, choice of next position for any particle, and hence where all such freedom is denied there can be no radiation. Hence by the second definition such a star is approaching the absolute zero and is therefore the coldest matter in the universe. Furthermore, matter in this condition has become strictly analogous to a molecule containing no excess energy which it can radiate away, and so the ultimate state of a white dwarf star is that it will be one great molecule.

Here the story ends, but we cannot do otherwise than demand a sequel. Such a final deadlock as above described is not in accordance with the trend of thought initiated by Galileo and deepened by the investigations of every succeeding natural philosopher into belief in " . . . the perpetual round of strange, Mysterious change."

If the old physics cannot solve the problem, and the new physics can go thus far and no farther, then we

must wait hopefully for a yet newer natural philosophy to carry the final chapter on the chemistry of the stars beyond the *status quo* of the star molecule.

"THE CHEMISTRY OF THE STARS."

To the Editor of DISCOVERY.

SIR,

With reference to my article in your October issue, "The Chemistry of the Stars," I think it might interest some of your readers to know that the progress of science is so rapid that during the period between sending my manuscript to you and its publication, two more molecules have been identified in stellar spectra and several elements.

Spectrograms of the famous variable star, Mira Ceti, when at its recent maximum brightness, revealed bands which have been identified with the chemical compound aluminium oxide, a substance hitherto unrecognized in the stellar atmospheres, and certainly not present in the hotter stars.

In the stars of types R and N, it was stated in my article that the band spectra arose from molecules of cyanogen, carbon monoxide, and hydrocarbons. Two spectroscopists have now put forward evidence for attributing some of these bands to the carbon molecule composed of two carbon atoms.

An exhaustive piece of work at the Mount Wilson Observatory has established with a strong probability the presence in the sun of the "rare earth" elements cerium, lanthanum, neodymium, samarium, europium, and ytterbium; while there is evidence for præsodymium, gadolinium, terbium, dysprosium and erbium, though much less conclusive. The elements illium, holmium and thulium cannot as yet be proved to be either present or absent.

Thanking you for offering me space to publish this "postscript" to my article, I am,

Faithfully yours,

A. VIBERT DOUGLAS.

The Macdonald Physics Laboratory,

McGill University, Montreal.

The Challenge of War Time to University Women*

By
A. VIBERT DOUGLAS

REPRINTED FROM THE MCGILL NEWS, AUTUMN, 1943

THE CHALLENGE to University Women to play a part in these stirring days is a very urgent challenge which no one of us has any right to ignore. To most of you there is no need to emphasize this point—you feel the challenge of the times and you hear the trumpet call to service and sacrifice. Your problem is to select the form of service for which you are best fitted and in which you are most needed. You can play a worthy part in the united effort required of our country in these anxious years whether you be in uniform or out of it, so long as you carry to your tasks the enthusiasm of a burning desire to contribute the best that is in you. Skill, patience, understanding, great honesty and hard work—we must give all these, and we must think and think and keep on thinking if we are to help in the attainment of victory and in the building of the world of a better tomorrow.

The enlisted services are calling for women with various skills and with no particular skill, but, above all, they are calling for women with qualities of leadership. There are over 34,000 women in the King's uniform today in the Canadian Navy, Army and Air Force. Some of our finest university graduates and undergraduates are giving leadership in these units. Their influence is being exerted to help keep the whole tone and standard of the women's units high and dignified. I think of an M.A. in English who was tennis champion at one of our universities a few years ago, and who is now in the R.C.A.F. (W.D.). I think of an excellent pass degree student, an assistant swimming instructor in her final year, who is now a sergeant in the C.W.A.C. I think of another student who took a B.Sc. a few years ago and who was one of the first to enlist in the Wrens. An undergraduate doing a brilliant first year course felt the call and did not return this session but is now doing radio duty on the west coast in an Air Force uniform. These young women are enthusiastic about their work and they and many others have expressed their certainty that they did the right thing when they enlisted. The services need more and more women with good home background and good education, and I commend this challenge to you with all sincerity and seriousness.

Some of you may have home responsibilities which render enlistment out of the question. Many of you may have a definite bent towards a civilian form of

service for which perhaps you also have or are taking special training. Such fields of service of national importance and urgently calling for women today are the teaching profession, nursing and medical work, the wide field of social work, the civil service with its branches requiring special academic qualifications such as censorship and accounting. I need not dwell upon these—the first four have a great social significance in both war and postwar years, while the last two are essential present needs. How far returned men will displace women in accountancy is not certain; but for women with language qualifications, the postwar reconstruction and rebuilding of education in Europe will offer a tremendous and a thrilling challenge, and there will be openings in the diplomatic service, in consular and trade commissioners' offices on every continent.

For women with some mathematical and laboratory knowledge of physics, there are the physical research openings, the gauge testing laboratories, electrical instrument testing jobs. I think of one young woman who taught for three years after Normal School, then went to a university for two years and wrote me last summer that she had decided to drop college for the duration. She is checking flying instruments in a Toronto laboratory and has the satisfaction of doing a skilled and essential job upon which our intrepid young airmen depend in large part for their safety.

Those of you with training in biochemistry, bacteriology and allied sciences are needed in hospital and research laboratories and in the units of the R.C.A.M.C. Chemists are needed in industry, in metallurgical laboratories and in war researches. The war has brought new duties and responsibilities to those trained in psychology and methods of psychological testing. All these are important fields where a woman with the requisite training can serve her country.

Some of you may have the ambition to go on beyond the Bachelor's degree to professional courses such as law, theology, library science, journalism; others may wish to take postgraduate courses of one kind or another, but without specific intent to train for a particular war or postwar job. Some of you may be even continuing an undergraduate course with no defined motive. The government has laid down very explicit regulations regarding men and how far they may legitimately go with their studies during these war years. Thus far, women have been left to decide for themselves where duty lies.

A. VIBERT DOUGLAS, M.B.E., M.Sc., Ph.D., F.R.A.S., for many years Lecturer in Astrophysics at McGill, is now Dean of Women at Queen's University, Kingston.

*Address to McGill Women's Union, R.V.C., March 20, 1943.

Are you justified in remaining at college another year? That question you must ask yourself. No one can decide for you, though many people may advise you one way or the other. Whether you be an undergraduate or a postgraduate student you must ask yourself that question. To return and train yourself further for a specific form of national service may be the obvious path of duty and wisdom. To get right out into a job which you are now fitted to do may be the only course which in the years to come may seem to you to have been justified. There are women today who were young adults in 1914-18 but who were asleep, never realizing that they could share in the service and to some small extent in the sacrifice of those years. They missed the opportunity of being active participants in a great experience. Do not make the same mistake.

In trying to help you to a decision I have touched upon some of the forms of service for which university training is essential. Now I am going to tell you my own experience. When war was declared on August 4, 1914, I had completed my second year of the four year B.A. course at McGill. I returned to college that autumn and carried through my third year. In August, 1915, I decided to leave my undergraduate course unfinished and I went to England in September. My first paid job was in the Customs House between Billingsgate Market and the Tower of London, overlooking that portion of the Thames known as The Pool. Here I took the place of an enlisted man as a "Debenture clerk." Later I transferred to the War Office and was immersed in the statistical work relating to recruiting and national service with the whole manpower of Great Britain as background. At the end of the summer of 1919, I returned to Canada and entered my fourth year at McGill that autumn. Four

years had elapsed and, of course, I had forgotten a vast amount and, of course, it was hard work picking up the threads. But I assure you it can be done. Hundreds of returned soldiers did it, and we all brought to our studies a greater maturity of mind and judgment. It was a hard year but it was a great year. The experiences of those war years form some of my richest memories and never have I for a moment regretted breaking my course as I did. There is the satisfaction of feeling that one played a part, even though it was a very small and humble part, in the great events of those momentous years. A rich store of experience was gained which has influenced all my subsequent life. I covet for you some such memories when you look back from middle age upon these days of challenge and great opportunity.

Recently, I have realized as never before, how much the world can ask of us, how much we are expected to know about many things. It is not enough to be a specialist in something. We must also be intelligent citizens, aware of what is happening in the world, aware of the trends of constructive thought in the world about us, ready to assume a measure of responsibility for moulding a sound honest public opinion, and willing to pull our weight in whatever way we honestly think that we can render the greatest service.

In a Montreal newspaper last autumn I saw a drawing of a vast expanse of ocean with wild cold waves to a far horizon—a dark bleak lonely waste. An airplane trailing a long plume of black smoke was falling headlong into the sea. Four words told the story: "He gave his life." Here is a grim challenge to each of us to fill these war years with some effort of which we need never be ashamed. Nothing short of our best will seem good enough when we look back upon these years.

A. Douglas

A. VIBERT DOUGLAS

Canada's Stake in Unesco

(Reprinted from CULTURE XVI [1955] 316-324)

CULTURE
733, de l'Alverne Street
QUEBEC

Canada's Stake in Unesco

A. VIBERT DOUGLAS
Queen's University, Kingston

Canada has a twofold stake in the United Nations Educational, Scientific and Cultural Organization. One is financial. We shall contribute 2.7% of the total budget of Unesco for the 1955,56 period between the VIIIth and the IXth Conferences. This is Canada's percentage on the U.N. scale of contributions and, as the VIIIth Conference held in Montevideo, Uruguay in November-December 1954 fixed the budget for the two year period at \$20,000,000 the Canadian taxpayers are responsible for \$270,000 per year.

Canadians should know for what purposes this money and the 97% of the total budget which is contributed by seventy-one other nations are spent. They should know too that Canada has a stake in Unesco of a kind other than dollars and cents. We were in Unesco from its earliest hours when a Canadian educator, the late R.C. Wallace, was active at the preliminary conference where a vague idea crystallized out into an actuality. Having no National Commission for Unesco — Canada is one of only four nations to have no such Commission — the full interest of our educators and others engaged in scientific and cultural activities has never been aroused. Our contribution in ideas can only be as great as it should be when our potential contributors of ideas become active contributors through the type of national organization already functioning in 68 of Unesco's member nations.

How Unesco Aids Education

Since the policy of Unesco is not to duplicate existing organizations, but rather to coordinate their efforts and to strengthen them financially, a large number of 'subventions' are voted by the General Conference on the recommendation of the Director General and the Executive Board. The sums involved vary from a minimum subvention of \$2,000 per year to such organizations as the International Association of Vocational Guidance, The World Federation of Mental Health and the Joint Committee of International Teachers' Federation (membership 4 million in

49 countries) to \$6,500 per year to the International Bureau of Education and \$14,000 to the International Association of Universities (184 universities in 49 countries).

Other organizations include the World Confederation of Organizations of the Teaching Profession (with which many Canadian teachers are associated), the International Federation of Workers' Educational Associations (which does outstanding work in Great Britain, for example, and with this assistance from Unesco the IFWEA will extend its conferences and summer courses in Africa and Asia).

Unesco has played a small but important part in encouraging the Children's Communities, since the pioneer Community was established in Switzerland for children of neighbouring countries, homeless through the tragedies of war. Following a conference convened by Unesco 250 Communities were federated in 1948, France, Belgium, Italy, Luxemburg, Netherlands and Israel having followed the example of Switzerland by establishing such Communities.

Cooperating with the United Nations Relief and Works Agency in the overwhelming problem of over 800,000 Arab refugees from Palestine now in camps in Jordan, Lebanon, Syria and Egypt, Unesco has helped to make primary education available to all the children, and secondary education to a selected 5%. Vocational and technical training are being steadily increased, and also teacher training and conferences to improve teaching methods.

Korea has presented a challenge to the United Nations and on Unesco rests the responsibility for giving educational direction and supervision, providing training abroad for Korean teachers and for selected scholars.

"The most publicized statement made by Unesco is . . . that over one-half of the adult men and women in the world can neither read nor write." With this reminder the programme of FUNDAMENTAL EDUCATION was introduced. Since "this basic ignorance is directly related to the ill-health, undernourishment, low productivity and general condition of misery of so large a proportion of the population of the world", Unesco will spend 33% of its entire budget for education on fundamental education. This means supporting training centres for teachers who will combat illiteracy,

teach uneducated people "to improve their condition of life within the environment in which they live" with emphasis on problems of health, nutrition, local productivity and community enterprise with the village school as the natural centre for this activity.

In 1951 Unesco established a fundamental education Centre for Latin America at Pazcuara, Mexico. An eighteen month course of training is given, with Unesco scholarships provided for each of the countries of South and Central America where illiteracy is a pressing and urgent problem. Already 110 teachers have graduated. Two years later a similar Centre for the Arab States was set up at Sirs-ol-Layyan in Egypt with a 19 month training programme, extended in 1955 to a two year course with 60 new students to be enrolled. The expectation is that gradually Unesco support may be replaced by governmental support from the states whose needs the Centres are serving. At Montevideo it was argued that states would feel more responsibility for the wisest use of these trained teachers if they had made a direct investment in their training.

ADULT EDUCATION is served by Unesco in several ways: by assisting summer schools and training courses for leaders, especially in under developed areas and where the education of women has been neglected; by the organization of an International Centre in France where problems of workers' education can be investigated and summer schools for workers can be held; by the establishment of Youth Centres, exchange of information on Youth Education programmes, study projects and seminars for youth leaders in South Asia, the Far East and Pacific area and in Latin America, and in particular at the Unesco Youth Institute established in 1951 at Gauting near Munich and at the Institute for Education in Hamburg.

An important part of the adult education work of Unesco is the organization of study tours for workers, the industrial, agricultural and 'white collar' workers. Underlying all such study tours and indeed underlying all Unesco's activities is the basic intention of promoting international understanding and intelligent knowledge of the United Nations, its ideals, achievements and activities. The Secretariat anticipates applications from some 150 workers' organizations which will want to participate in the 1955 Unesco Study Tours.

How Unesco Aids Natural Science

Introducing the section of the 1955, 56 programme of assistance in the field of Natural Science, we read a declaration of faith that progress in science and technology not only brings about physical liberation from many of "the shackles of nature", but "there is also a spiritual liberation which comes with an increasingly accurate understanding of the material world" — and this will give to mankind a greater "confidence in himself and profound hope in his future".

First, then, is Unesco's concern with international cooperation in scientific research. A subvention of \$180,000 per annum is made to the International Council of Scientific Unions (ICSU), federating eleven international unions — Astronomy, Geodesy and Geophysics, Pure and Applied Chemistry, Pure and Applied Physics, Biological Sciences, Mathematics, Radio Science, Geography, Crystallography, Theoretical and Applied Mechanics, History of Science. This money is largely used for meetings, special symposia, publications and permanent activities of the Unions. As one example the triennial General Assembly of the International Astronomical Union may be cited. In 1952 it met in Rome where over 400 astronomers gathered from 34 countries and the programme was unforgettably enriched by a special symposium on Stellar Evolution. The Ninth General Assembly of this I.A.U. will take place in Dublin at the close of August this year with special symposia being held on Non-stable Stars and on a Comparison of the large-scale Structure of our Galaxy with that of Other Galaxies. Preceding this Congress a Joint Commission of ICSU will meet in London to focus international scientific attention upon Solar Eclipses and the Ionosphere. Thus by its subvention to ICSU does Unesco aid and encourage scientific research at the highest level.

In like manner the Council for Medical Sciences (CIOMS) is given a subvention, but only 10% of that given ICSU since the World Health Organization has a direct interest in supporting this Council also. Another Union is that of the Engineering Associations (UATI) of 57 countries. To this Unesco gives \$12,000 per annum.

Unesco is active in coordinating and supporting certain specific international scientific activities. One of great importance, is the ICSU project known as the International GEOPHYSICAL YEAR, 1957-58 which will involve

concerted efforts of astronomers, geophysicists, meteorologists and radio researchers. Preparations for this are already well under way, with Canada playing a prominent part.

Other international projects are Arid Zone Research which includes a symposium on climate and soil erosion; Humid Tropical Zone Research; Physical Oceanography and Marine Biology, a study to be made jointly with the Food and Agricultural Organization (FAO) beginning with the Indo-Pacific region; and the latest addition, Basic Research on Cellular Growth, agreed upon only after three debates at Montevideo in which all the anglo-saxon countries and a few others urged that Unesco keep out of a field already well organized in many countries with millions of dollars involved in what is in effect research on cancer.

In order to promote regional coordination of scientific facilities and exchange of information, Unesco maintains Science Cooperation Offices in Latin America, the Middle East and in Asia. It organizes translation and distribution of scientific papers — especially in physics and chemistry and it sends experts on request to aid underdeveloped countries in specific problems. Brazil, Bolivia, Indonesia and the Philippines have asked for experts to assist them to develop education in nuclear physics and cosmic rays. Ecuador has requested an expert to help them remodel their observatory situated on the equator near Quito. Pakistan reported that as a result of Unesco's assistance in 1950-52 especially in providing four experts in seismology, geomagnetism and atmospheric physics (from Denmark, Germany, the United Kingdom and Australia), the Geophysical Observatory at Quetta "is now ranked by competent authorities to be one of the finest institutions of its kind in South East Asia", and this is an excellent example of Unesco's policy of Technical Assistance.

Unesco and the Social Sciences

In the field of the social sciences Unesco gives subventions to internationally organized bodies such as the Social Science Council, the Economic, the Political Science and the Sociological Associations, the Committee for Comparative Law, the Union of Scientific Psychology, and of course Documentation is not overlooked, nor is the International Statistical Institute.

Unesco established the first International Statistical Education Centre in 1950 in Calcutta. After three years its support came almost entirely from the Government of India, so Unesco opened a second such Centre in Lebanon to serve students of the Middle East.

The Unesco Institute for Social Sciences was set up in Cologne in 1951 with liberal support from the German Federal Republic. It has become an active centre for sociological studies and research.

Much bibliographical and statistical work is assisted and studies are initiated in methods of social science teaching, race tensions, human rights and minorities, cultural assimilation of migrants.

The intensification of social problems and the creation of new problems by the rise of industrialization are not forgotten by Unesco, and a Centre for Research on these problems is now being planned for South Asia.

No social scientists are happy unless something is being "evaluated", and this is reflected in Unesco's earmarking of a few thousand dollars to evaluate (a) the effect of a new public library in a working class quarter of Delhi. (b) a literacy campaign making use of visual aids and radio broadcasts. (c) the long-range effects of international seminars. Evaluation techniques themselves will come in for critical review by 'a group of experts'.

Unesco's Support of Cultural Activities

A subvention of \$95,000 a year is given the International Council for Philosophy and Humanistic Studies (ICPHS). Smaller sums go to aid the internationally organized Council of Museums, Theatre Institute, Music Council, Union of Architects, PEN Club, Library Association, Archives, Visual Arts, and Federation for Documentation.

Through its member states Unesco is attempting to arouse and sustain interest in the Universal Copyright Convention, the Convention for Protection of Cultural Property, the removal of obstacles to international exchange of radio and television programmes, exchange of publications and microfilms of documents, regulations with regard to archaeological excavations and the preservation of monuments and museum objects.

A special and urgent project for which \$21,000 has been voted is the cataloguing and preservation of Middle Eastern manuscripts. A further

like amount will provide Technical Aid to countries requesting expert assistance at archaeological and historical sites. A good example of this type of Unesco's activity is provided by the remarkable restoration of 16th and 17th century Spanish churches and palaces and the excavation of the ancient Inca foundations of great buildings and temples at and near Cuzco in the high Andes of Peru, when after the destructive earthquake of 1950, the Peruvian government requested Unesco to send historians and archaeologists to advise in the reconstruction of the city.

The cultural activities necessarily are closely integrated with education. Examples are the production of reading material specially designed for new literates; public library development in Asia, in Africa and in Colombia; education for librarianship in the Arab states; development of museums; a mobile microfilming unit for Latin America; travelling exhibitions of many kinds.

Two ambitious projects may also be mentioned here. In 1950 Unesco entrusted to an international commission of scholars of 40 nations the preparation of a History of the Scientific and Cultural Development of Mankind. The six volumes now in process of compilation may be completed by the close of 1956. This has been a costly undertaking. The commitment for this two year period is \$115,000. A new project approved at Montevideo is a Directory of World Literature since "there has never been any adequate list of the masterpieces of world literature".

Mass Communications in the service of Unesco's aims

The promotion of international understanding, the free flow of information, the diffusion of knowledge by all possible channels of mass communication are of basic concern to Unesco. The printed word, radio, films, television and exhibitions are all means to these ends and Unesco aids in developing all these by cooperation with communications research institutes; by special attention to press, film and radio for children; by documentary films; by assistance to The World Braille Council; and through special projects in needy countries in the fundamental and workers' education fields.

Unesco enlisted voluntary international assistance through the scheme of GIFT COUPONS for books, films, scientific materials and also Travel

Coupons. More than a dozen countries have now become donors — Australia, Canada, Denmark, France, Germany, Japan, Netherlands, New Zealand, Sweden, U.S.A. and United Kingdom. Norway and Israel through the Coupon scheme have given special aid to the Greek schools in the earthquake area. By means of these Unesco coupons serious currency exchange difficulties are circumvented and by 1953 more than a million individuals representing many hundreds of national and local organizations had become participants in Unesco's work.

Unesco Promotes Exchange of Persons

Under this heading comes Unesco's large and exceedingly fruitful programme of FELLOWSHIPS and STUDY TOURS.

To encourage and facilitate people, particularly scholars and workers to see something of countries other than their own, Unesco publishes and keeps up to date the handbooks *Study Abroad*, *Vacations Abroad*, *Travel Abroad*, *Workers Abroad*, *Teaching Abroad*.

Unesco fellowships for the purpose of training teachers for the various projects under the general heading of Education number about 30 each year. In the Natural Science section are three fellowships for training research workers in geophysics, six for arid zone research, four for oceanography and marine biology, and three for training in workshop methods of teaching natural sciences.

For educational statistics and for teaching and research in Social Sciences seven fellowships are available in 1955 and fourteen in 1956.

In the field of Cultural Activities, seven fellowships are given to artists and writers each year, four for the training of librarians, two for museum workers and two fellowships in arts and crafts.

Under the heading Exchange of Workers are the Study Tours already referred to and these are planned for Europe, Latin America and South East Asia.

Conclusion

The wide range of Unesco's interests cannot but be a revelation to those hitherto unfamiliar with its programme. The faith of the founders of Unesco

is the faith of those now engaged in its operations — faith that international cooperation in the things of the mind makes a wholly constructive contribution towards attainment of the great ideals of international understanding and peaceful coexistence.

With the entry into Unesco in 1954 of Soviet Russia an era of greatly expanded influence and widened frontiers of operation has opened up. All the wisdom, all the intellectual and cultural resources of the member nations are needed. Canadians must have an effective national organization through which knowledge of Unesco and ideas about Unesco may be transmitted if we are to make the contribution to Unesco which other nations quite obviously expect from Canada.

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ADVISORY COMMITTEE
ON
RECONSTRUCTION

VI. POST-WAR PROBLEMS OF WOMEN

Final Report of the Subcommittee

November 30, 1943



OTTAWA
EDMOND CLOUTIER
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1944

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ADVISORY COMMITTEE
ON
RECONSTRUCTION

The reports of the Advisory Committee on Reconstruction consist of a Committee Report and reports by Subcommittees under the following titles:—

- I. Agricultural Policy.
- II. Conservation and Development of Natural Resources.
- III. Publicly-Financed Construction Projects.
- IV. Housing and Community Planning.
- V. Post-war Employment Opportunities.
- VI. Post-war Problems of Women.

November 30, 1943

VI. SUBCOMMITTEE ON POST-WAR PROBLEMS OF WOMEN

FINAL REPORT

Terms of Reference

In January, 1943, the Subcommittee on Post-war Problems of Women, the last of the subcommittees to be appointed by the Advisory Committee on Reconstruction, was organized, and given the following terms of reference:—

To examine the problems relating to the re-establishment of women after the war and to make recommendations to the Committee on Reconstruction as to the procedure to deal with the problems and other matters relating to the welfare of women in the period of reconstruction.

Membership

At the outset only the Chairman and four members had found themselves free to accept membership in the subcommittee and suggestions for additional members were requested. No representative basis of any kind was used for the choice of members who were ten in number:—

Mrs. R. F. McWilliams, Chairman, Winnipeg; Mrs. Harvey Agnew, Toronto; Dr. A. Vibert Douglas, Kingston; Miss Marion Findlay, Toronto; Madame C. Frémont, Quebec; Mrs. R. B. Gunn, Lloydminster, Alta.; Mrs. Sherwod Lett, Vancouver; Mrs. Grace W. MacInnis, Vancouver; Mrs. N. A. M. MacKenzie, Fredericton; Miss Margaret Wherry, Montreal; Dr. L. C. Marsh (Research Adviser); Mrs. F. E. Hurst (Secretary).

Appointments, Meetings and Reports

Chairman appointed and four members January 11, 1943.

Three additional members appointed by February, 1943.

First meeting, Ottawa, March 22, 23, 24, 1943.

Two more members appointed April, 1943.

Second meeting, Winnipeg, April 26, 27, 1943.

Report on Social Security in Relation to Women, May, 1943.

Meeting planned for Ottawa, June, 1943, cancelled by Chairman, Committee on Reconstruction.

Third meeting, Ottawa, August 27, 28, 29, 1943.

Fourth meeting, Ottawa, November 18, 19, 20, 21, 1943.

Report on Post-war Problems of Women, November 30, 1943.

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At the outset only the Chairman and four members had found themselves able to accept membership in the subcommittee and suggestions for additional members were rejected. No representative basis of any kind was used for the date of members who were ten in number:—

- Mrs. R. E. Hurst (Secretary);
- Mrs. J. E. Hurst (Secretary);
- Miss Margaret Wherry, Montreal; Dr. J. C. Marsh (Research Director);
- Miss Mary MacRae, Vancouver; Mrs. K. A. M. MacRae;
- Miss Grace W. MacRae, Vancouver; Mrs. J. B. Goss, Edmonton; Mrs. J. B. Goss;
- Dr. A. H. Douglas, Kingston; Miss Marion Finlay, Toronto; Madam G. Dr. A. H. Douglas, Kingston; Mrs. J. E. Hurst (Secretary);

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I. BASIC ASSUMPTIONS UNDERLYING THE REPORT

1. The report is predicated on the assumption that full employment will be the objective of all economic policy in Canada after the war.
2. Postwar problems of women cannot be considered apart from the post-war problems of society in general.
3. In the work and sacrifice of the war years women have played their full part as responsible citizens and expect to be treated consistently as such in the coming years. Their hope is to be full members of a free community.

II. SIZE OF PROBLEM

1. The Pool of Woman-Power

In seeking to find some method of measuring the number of women who come within the terms of reference given to us, it soon became evident that it was impossible to segregate any special groups or numbers of women employed in war occupations. It is difficult to define precisely what are war industries, and there is the further fact that many women went to work in what might not be called a war industry to release men for the forces or for essential war industry. These women, it seemed to us, should be included in any discussion of the post-war problems of women engaged in war industry. We, therefore, decided to include the whole group of employed women in our studies.

Under expert advice we have taken the following picture of the pool from which woman-power is drawn as it was just before the beginning of the war:—

Total number of women available.....	3,000,000
Married women.....	2,000,000
Single women.....	1,000,000

The following two tables, based upon figures supplied by the Dominion Bureau of Statistics and the Department of Labour, show the progress of the entry of women into the ranks of employed women due to the demands of the war, and their progressive distribution:—

Numbers of Women Employed in Industry, June 1939-November 1942

June, 1939	June, 1940	June, 1941	June, 1942	Oct., 1942	Nov., 1943
600,000	620,000	720,000	962,000	1,073,000	1,200,000

Of the 1,200,000 women employed in November, 1943, 260,000 are engaged in direct or indirect war industry.

Distribution of Employed Women: Estimated numbers of women employed June 1939 to October 1942

	June, 1939	June, 1940	June, 1941	June, 1942	Oct., 1942	Jan. 30, 1943
Agriculture	2,000	2,000	2,800	3,000	.....	.....
Forestry, fishing, hunting	400	500	600	1,000	1,600	.....
Mining	600	600	600	1,000	1,600	.....
Manufactures	111,000	129,000	174,200	261,000	301,000	373,000
Construction	1,000	1,000	1,500	2,000	2,600	4,000
Transportation and Communication	18,000	18,000	20,300	26,000	30,000	31,000
Trade and Finance	111,000	114,000	126,400	164,000	182,000	180,000
Service	342,000	342,000	379,200	490,000	490,000	439,000

As at January 30, 1943, there were 3,310,000 persons employed in industry, so that women are now filling one out of every three jobs. It is clear also that 600,000 women have been drawn into the ranks of the employed who were not working in June, 1939. As there were at that time 85,000 women only, seeking work, it follows that over 500,000 new workers have been drawn into the ranks of the employed.

These figures take no account of the women in the forces, who numbered nearly 38,000 in November, 1943. The problems arising out of the demobilization and rehabilitation of this group have been dealt with by the General Advisory Committee on Demobilization and Rehabilitation, and are not dealt with here. The factors relating to women's employment, which are discussed in this report, will apply in equal measure to those service women who seek employment after discharge, or following the completion of a training course.

2. The Post-war Problem of Women Now Employed

In considering this problem, the first question asked was how many women will wish to continue in the ranks of the gainfully employed.

The Committee decided it would be useful to have some indication of what women workers in war industries are thinking regarding their position in the postwar period. For this purpose questionnaires were distributed among women employees in several war plants. This was a preliminary study only and it was our intention to suggest a survey if the results of a small sample indicated the desirability of obtaining fuller information in this way. This is not now possible because of the termination of the Committee's work.

The replies to the questionnaires reveal the interest and concern in this whole question on the part of both the women and their employers, and in certain plants the subject is receiving further consideration.

While the evidence of a small sample cannot be considered conclusive, it indicates the intention of approximately one-half of these women and girls to withdraw from industry, and to resume or to enter the occupation of home-making. The percentage figure falls within the range of figures arrived at by certain other polls and estimates, namely 45 to 55 per cent. These figures should be taken as applying to the 600,000 women who have come into industry since 1939.

It may be of interest to note that valuable suggestions were offered by many of the women in connection with postwar problems and the re-employment of those for whom employment will be necessary. Many of them are in line with recommendations made in this report.

It is impossible to give any clear cut picture of the postwar position of women who will wish to be employed, but the available figures do give an indication.

It is a reasonable assumption that normal employment after the war, comparable to that of 1939, would raise the figure of 600,000, the number of women employed then, to 750,000.

Hence we have:

Women now working.....	1,200,000
Women required for normal employment at end of war.....	750,000
Leaving to be taken care of.....	450,000
From these may be deducted the expected number of women returning to their homes or marrying, 45 per cent of 600,000, or..	270,000
Leaving to be taken care of.....	180,000

This is undoubtedly a large number and will be increased somewhat by the number of women from the armed services who enter the labour market. We had hoped to analyse it further, and to consider more carefully where and how more employment might be found. All we can do now is to list the following factors which will operate to reduce this figure of 180,000 if full employment is attained after the war:—

- (a) Marriage in the group of 600,000 already working when war broke out.
- (b) The opportunities for women on the farms. The number of women who have left the farms is 95,000.
- (c) A possible expansion in household work if conditions are made more attractive.
- (d) A probable expansion in the distributive trades and services occupations.
- (e) New Government services such as health insurance, or security measures and housing projects.
- (f) New industries such as the manufacture of plastics and household gadgets in which women workers may be wanted because their newly acquired skills will be easily adapted and because employers have found their women employees valuable and valued workers.

If thousands of women are not to be searching earnestly, if not desperately, for work, and depressing thereby the wages of men and women already working, it is essential that all possible measures to widen these channels of employment be undertaken. We urgently recommend that preparations to this end be begun forthwith.

III. APPROACH TO THE PROBLEM

Women in Canada may be divided into four groups:—

1. Married women engaged in their own homes, rearing their children and putting their best effort, physical, mental and spiritual into the creation of the home life.
2. Single women earning their own living. Most single women in Canada earn their livelihood, and public opinion increasingly expects it of them. In this connection, it may be stated, a considerable proportion of these single women are supporting dependents wholly or in part.
3. Married women who either by reason of economic conditions or by choice are engaged either in full or part-time work. It should be noted that this usually involves dual responsibility in that the home duties must still be carried on.
4. Women on the farms are considered in a group by themselves because they contribute to the earnings of the family income in a way that applies generally to farm life only. Thus, while they have all the problems of the woman in the home, they have also a special set of problems requiring separate attention.

The following general considerations apply to all groups:—

1. To women in each group the right to choose what occupation she will follow must be conceded as a right to which every citizen is entitled. She must also have the right to equality of remuneration, working conditions, and opportunity for advancement.
2. We believe that the right to choose is not going to operate to make every woman, or even much larger groups of women want to leave their homes for the labour market. It is the right to choose which is demanded. Happier homes, and, therefore, a happier democracy, will result from the recognition that women

choose or do not choose marriage as their vocation. It must be remembered that for many single women marriage will be an impossibility because of the casualties of the war.

3. Many women in all three groups will find their situations changed in the post-war years. A large proportion of the women now working, both married and single, have been earning money for the first time, or the first time since marriage. They have gained an entirely new realization of their skills and capacities. Many will return gladly to home life. Others will feel a sense of frustration if they have not the opportunity to exercise these abilities. For some public activities will serve, others will wish to be gainfully employed.

IV. GROUP I. MARRIED WOMEN IN THE HOME

A. General Factors

This is the largest group among Canadian women and the most important from the standpoint of the happiness and efficiency of the husband and children. Thus the homemaker gives a tremendous contribution to the building up of a healthy, happy and efficient Canadian people.

It follows that any government which desires to build a true democracy, of which such homes are the foundation, must do everything in its power to create conditions under which such homes can be successfully maintained.

Moreover, the homemaker, though classified in the census as not gainfully employed, is engaged in an occupation which has a vital economic value to the community. No one has expressed this so accurately and completely as Sir William Beveridge in his report on Social Security, page 49, section 107:—

In any measure of social policy in which regard is had to facts, the great majority of married women must be regarded as occupied on work which is vital though unpaid, without which their husbands could not do their paid work and without which the nation could not continue.

The economic value of the wife's work becomes clear if the cost to the husband of replacing the services rendered by the wife in her purely occupational aspects is kept in mind. We would like here to refer to the recommendation in our first report on Social Security in relation to women that the team or partnership policy advanced by Beveridge in relation to the married couple be adopted.

The opinion of many women in all classes appears to be that every effort of education ought to be used to present the view that the married woman who has children is serving her country well if she stays in her home and looks after her family, though at the same time the right of choice is hers. Actually it would seem that when the ban of public opinion on married women working is once removed the result would be a greater readiness to look on marriage as on a par with any other occupation.

For the accomplishment of this purpose we outline a number of measures which we recommend should be undertaken or encouraged by the Government.

B. Measures which will Contribute to the Successful Maintenance of Canadian Homes

1. Household Workers

One of the greatest assets a community can have is the harmonious, well-managed home. The level of home life will be raised only if women, whether employers or employees, are better trained for their jobs as household workers.

The Problem. It is anticipated that for a long time in the future, as in the past, household workers will continue to be the largest, or one of the largest,

groups of gainfully occupied women. The problem is to make the vocation of household work sufficiently attractive to hold more adequate numbers of well-trained intelligent girls and women. On the other hand, housewives are entitled to the competent services of well-trained household workers. To accomplish this, it is necessary to establish in the minds of employers the principle that payment for services should be in just proportion to the importance of these services, and that, on the other hand, the status of household work should be raised by the standards of training to the dignity of a vocation.

Importance of the Problem. The problem of the household workers deserves special attention for four main reasons:—

- i. Prior to the war, there were more workers in this category than in any other and many present-day war workers could be reabsorbed into the peacetime economy through this channel.
- ii. The skilled household worker makes a significant contribution to the health and well-being of the family. Good household workers also are essential if highly trained professional and business women are to make an adequate return to the state for their expensive education.
- iii. It must be realized that the social progress of a country depends to a very large extent upon the voluntary efforts of women who give their time to the community. Under war conditions with the prevailing shortage of household workers, it has become increasingly difficult for women to make this contribution. The value of this voluntary service is incalculable, but it must be acknowledged that it depends largely upon competent household workers able to undertake the domestic duties of women who are willing to make this contribution to their communities.
- iv. The level of the economic life of the community is depressed by a large reserve of unskilled womanpower. Other groups of workers will have greater security if the status of household workers can be raised.

The Plan. We therefore recommend a plan partly old and partly new in Canada for raising the status of household workers. Its underlying essential features are:—

- i. A standard of proficiency should be set by a training program sponsored and financed by the Dominion and provincial governments. Graduates of the training course would be given proficiency certificates entitling them to recognition as skilled workers.
- ii. A signed agreement between employer and employee, made through National Selective Service in co-operation with the training schools, would protect both employee and employer by providing at least a written statement regarding wages, termination of employment and other working conditions. We have noted that efforts are being made to establish a national labour code. Should an agreement be reached between the Dominion and the provinces in favour of applying the Labour Code to peacetime industries, we urge that it include household workers.
- iii. Labour legislation should be amended when necessary to include household workers under the Minimum Wage Acts and other related legislation.
- iv. The occupational branches of social insurance should be open to household workers, i.e., Unemployment Insurance, Workmen's Compensation.
- v. National Selective Service should encourage young women to attend training schools for household work.

- vi. An organized supply of trained part-time workers should be made available to fill a great and immediate need for various types of household service. This kind of service is particularly required in homes of moderate income where it is impossible for the housewife with several children to have full-time assistance.
- vii. The cost of providing training should be borne by the government. The student should carry her own living expenses during training with the help, when necessary, of government loans at low rates of interest.

Training Program. Any training plan for housework should be included as an integrated part of a government post-war training plan. Such a training plan should develop a uniform standard of proficiency and a craft pride comparable to that obtaining in other skilled trades. It should also include, so far as may be possible, some general education.

After completing the course successfully, a trainee would be entitled to a certificate of proficiency. The holder of such a certificate would have more assurance of better wages and working conditions generally than an unqualified worker.

Training can be given in four different ways, each of which meets a special situation:

- i. *Part-time training—part-time employment.* In order to provide for comparatively rapid training of a large number of young women, we recommend a plan which has been successfully tried for some time in European countries, especially in France. The main feature of this plan is that it permits the young woman to work while she is receiving training.

Under an arrangement agreed upon by the training school and the employer a regulated number of hours of work can be done in the home, the rest of the time being devoted to study in classes. In these classes courses would be given, specially planned by experts and taught by skilled teachers. Experimental work can then be carried out within the home with the cooperation of the employer. It would be necessary in any such plan, at least in the early stages, that careful choice both of employer and trainee be made. This would be best done probably by National Selective Service in co-operation with the training authority.

- ii. *Full-time training.* This would be a continuation of the training scheme operated by the government in the later years of the depression, though such training need not necessarily be confined to that kind of school. Any approved teaching institution could be used so long as it met the government standard. This method proved itself, but produces trained women too slowly unless the number of schools were greatly multiplied.

During the two years of their existence these schools trained 7,000 workers at a time when there were nearly one quarter of a million workers in household and allied services.

- iii. *Short-term courses.* These would probably be most needed in the evenings, and would be given by the training schools to enable already experienced workers to qualify for the proficiency certificate without loss of employment and without unnecessary duplication of training.
- iv. *Continuation Courses.* These would be given by the training schools along specialized lines of household and allied work, e.g., special cookery household management, hotel and cafe work, invalid and child care. This would enable experienced workers to improve their skills and so qualify for a better position.

All these courses so far as possible, should include some general education.

A necessary condition for success in the rehabilitation of the household worker and the raising of her social status to a place commensurate with the vital importance of her vocation is a change in the attitude of employers. Unwillingness to recognize the value of the houseworker's service and to give her adequate remuneration both in the form of wages and good working conditions has been the stumbling block in the way of improvement in this field.

When the time comes to implement seriously the above recommendations full co-operation of the women's national organizations should be sought. Their aid in a campaign of information and education would be invaluable and we have reason to believe that this aid would be forthcoming. It is also important, if the co-operation of the women most concerned is to be secured, that provision be made for the representation of both the housewives and trained household workers on advisory committees or boards of management of all the training schools.

2. Children's Allowances.

Though we dealt with this question in our Report on Social Security we feel it is of such importance in relation to the present discussion that we quote from the Report:—

The introduction of a system of children's allowances has the strong support of your Subcommittee and it hopes that the establishment of this system will follow health insurance as soon as possible. It is the only system yet devised which will remove the poverty arising from the fact that a man's wage must be based on the product of a man's labour and not on the size of his family. Your subcommittee believes that these allowances should apply to all families with children.

Your subcommittee would like to see adequate allowances, but believes it to be of first importance to get the principle established and, therefore, would be willing to support in the beginning a smaller allowance than would be adequate to achieve the full purpose—health, proper food and clothing, education and desirable conditions of family life for the children. These allowances, which will necessarily be non-contributory and be paid from the national treasury, should be on a graduated scale, increasing with the age of the child and should be paid to the mother or to the authorized guardian taking the place of the mother.

In relation to children's allowances, your subcommittee wishes to suggest that an educational program on the subject of these allowances should be undertaken at once, as it believes the public generally is unfamiliar with the idea of children's allowances and the benefits which will be derived from such a system.

There is a new psychological factor in the present situation which will, we believe, add value to the giving of children's allowances. As we have already pointed out, a considerable proportion of the women who have been doing war work plan to return to the life of homemaker. They have been earning their own money, much of which has been spent on their homes and their children. The addition to the family income from children's allowances paid to the mother and by her spent for the welfare of her children may well be an alleviating factor in the mental attitude which may result from the surrender of the double income.

3. Social Security.

We wish to refer to our Report on this problem and to repeat the recommendations made therein. In particular, we urge the speedy implementation of health insurance.

4. Housing.

Knowing that another committee has given long and careful study to the problems of housing we wish merely to stress briefly certain aspects of housing which bear directly on the well-being of the family.

In our opinion houses and flats must be planned with adequate household conveniences that will materially lessen the time-consuming drudgery of housework; they must also be planned to provide for the varying needs of the family for privacy, work and recreation. Experience proves that juvenile delinquency is, in great measure, the result of overcrowded and bad housing. Well-planned dwellings have a beneficial effect on the health, morale, and development of the family and so of the community.

We cannot too strongly urge that as it is women who work in the homes and who must largely create the family life therein, they should have an immediate and responsible share in the planning and carrying through of all housing programs.

5. Nursery Schools.

As a war emergency, day nurseries have been established in several Canadian provinces under Dominion-provincial auspices to relieve the problem of caring for children of mothers employed in essential work. These day nurseries are proving their value as a temporary measure, and are meeting general approval where they are known. The value of such a service should not be lost to the community in the post-war period. The problem is to substitute for these war-time day nurseries something more suited to peace-time conditions. This would be nursery schools.

For years Britain and some of the more advanced European countries have had nursery schools as a part of their regular system of child care. For many years too in certain sections of Canada there has been steady growth in the nursery school movement. Experience has shown these schools to be of great value in promoting the welfare and development of the child through the discipline of group activity. It should be noted that a large proportion of the families in Canada consist of only one child.

The purpose of such nursery schools, operating from nine in the morning until noon, is not to substitute for but to supplement the home, providing certain educational advantages difficult to arrange in a single home, for example:—

Supervised play.

Space and adequate play equipment.

Companionship.

Consistent routine.

Careful supervision of health.

Among the chief advantages which the nursery school brings to the mother are the following:—

- i. Such schools make it possible for mothers to complete their household responsibilities and free them to be with their children for the remainder of the day.
- ii. Every woman should for her own sake and that of her family have time for outside interests. There is a large volume of valuable community service contributed by women throughout Canada. Such schools would enable women to be free for these activities.
- iii. These schools would also care for the children of married women who need or wish to work outside their homes, for a part of the day.
- iv. The nursery school is a source of information and becomes a natural centre where parents may discuss the progress of their families. In this way the benefits of the nursery school are carried into the home and serve to reinforce its best teaching.

As one of the measures desirable for the post-war period we favour the extension of nursery schools and their inclusion in the educational system.

V. GROUP 2. SINGLE WOMEN EARNING THEIR OWN LIVING

A. General Factors

A survey of over 600,000 women now gainfully employed has revealed that 26.9 per cent of the group, which did not include household workers, agricultural workers or government employees, are married. It is believed by those who have been studying the problem that the 1,200,000 women now gainfully employed may be divided thus:

Single Women	876,000 or 73 per cent
Married Women	324,000 or 27 per cent

1,200,000 or 100 per cent

It is not possible to distinguish in what occupations women are working. The figures shift so rapidly that an accurate picture cannot be obtained. We do know that there are about one quarter of a million in war industry, direct and indirect, and nearly another million in industry.

When we come to look forward to jobs after the war we find it equally impossible to be definite. Large employers of labour have given us to understand that plans for the post-war period have been made. All we have consulted, however, tell us that the carrying out of these plans depends upon whether or not full employment is to be realized, and thus they cannot give us any definite indication of the numbers of workers likely to be needed nor can they distinguish between jobs for men and women, even in the cases where the number of jobs may be estimated. All we can do, therefore, is fall back on our statement in Section I that we believe the outside number of women to be looked after would be 180,000 to 200,000. We have to consider what opportunities can be forecast without any definite basis upon which to work.

However, there are certain possibilities, even probabilities, which may be pointed out. The most positive and clear-cut of these lies in the fact that nearly 100,000 women have left the farms. We are informed that with the advance of farm machinery and farming methods it is not likely that this number of women will be absorbed into farm life. Nevertheless, this life and its occupations offer the most wide-open single opportunity for women now engaged in work caused by the war. It is for this reason that we urge so strongly that cognizance be taken of this fact, and plans be made for the improvement of conditions surrounding farm life.

We think it may be considered certain also that if there is full employment there will be a considerable expansion of the employment of household workers, provided that conditions are such as to make young women willing to go back into that pursuit. There will be not so great but certainly a relative expansion in all the service fields, except perhaps that of hotel work, where the number of women now employed is larger than normal.

All the distributive trades in which women are so largely engaged would also seem to be due for great expansion if the general purchasing power of the country is increased beyond what it was before the war, and the supply of goods is made available.

All of this takes no cognizance of the unknown field of industrial expansion, but when certain factors are put together it would seem probable that there will be a large increase in the employment of women in industry compared with conditions at the beginning of the war. In passing it may be noted that the heads of the textile industry have told us that there will be no marked releasing of women from their industry in the transition period.

A group which will require particular attention is one numbering approximately 43,000 in all in the Government Service throughout Canada. Of these, almost 35,000 are employed in Ottawa and represent an increase of 25,000 over prewar years. If allowance is made for an increase over prewar conditions, which

seems certain, and for a proportionate number returning to home life, it would still appear that there will be somewhere between 12,000 and 15,000 who will have to seek new employment. In our opinion this constitutes a difficult problem since many of these workers are young, away from home for the first time, and are largely working as juniors in the ranks with very little equipment or training. To this problem we have not had time to give detailed consideration. We feel, however, that it will be important that dismissals as they become necessary be made on a gradual scale.

Finally, we believe that at the present time the normal urge towards marriage, and home, and family life is strong, and that this is a factor which can be relied upon to reduce largely the number of women now listed as gainfully employed provided there is sufficient well-paid employment for men. If we are right, this will very much simplify the postwar problems of women.

B. Imperative Immediate Needs

It will be seen that if the degree of employment is great the post-war problem of the woman war worker is likely to be one of shifting to other jobs. If the degree of employment is less than is expected, the problem will be one of finding and even creating jobs.

A factor within the control of government, which can do more than any one other thing to mitigate the hardships and reduce the difficulties of the transition period from war to civilian occupations, is effective employment service in which both employer and employee have confidence. We have heard with much satisfaction of the effective plan adopted by National Selective Service in instances where lay-offs have already taken place of sending their officials into the plant in advance of the lay-off and thus placing every worker in a new job before the day of discharge. We think this kind of service should be encouraged, even if it entails an enlarged staff. It is one of the things which would contribute to confidence and orderly movement in the transition period.

In the time it has been in existence National Selective Service has accomplished much more under difficult circumstances. It is obvious that it must now develop in the direction of acquiring a more highly trained staff capable of providing vocational guidance and wise, efficient placement. We are glad to learn that already there is a beginning of this work within the Service, and we urgently recommend that every possible aid and encouragement be given in the development of these courses, and in enabling members of the staff to take advantage of them.

If, after the immediate postwar period when many controls may be relaxed and when it may be deemed advisable to merge National Selective Service into the Dominion Employment Service, we believe that the latter should enlarge its prewar functions to include vocational guidance, retaining the trained staff necessary thereto. It should also at all times have a top-ranking woman among those directing its work.

It is not only in Selective Service that women skilled in vocational guidance, administrative work, personnel work and some of the branches of social work are urgently required. There is grave need for these throughout the country. We think it is imperative that educated and potentially able women, many of whom are not now doing work commensurate with their abilities and education, should be drawn from industry by the co-operation of personnel officials and Selective Service and persuaded to take training. In order that this be done efficiently and quickly, the government should place full information regarding training facilities in the hands of these officials and instruct them to choose trainees from the ranks of the workers.

Schools for training social workers now exist in Canada. The other training courses may have to be organized. In order to induce more students to take such training it would be wise for the government to offer scholarships.

C. Training

The matter of retraining of such women war workers as may require it is of prime importance.

It seems probable that industry in many cases will prefer to do the retraining within its own establishments. Government insistence on adequate standards in such training should be continued through the transition period.

We are surprised and disappointed to learn that no plans are actually in definite preparation for such forms of training as the government may expect to have to undertake. We urge that preparation of such plans be begun immediately.

In considering the problem of training we believe that full use should be made of all the facilities of the various schools and private institutions in the country under some system of control or inspection which would ensure a good standard. We understand that Dr. George Weir has in preparation for the Rehabilitation Branch, Department of Pensions and National Health, a survey of all training facilities in Canada. We had arranged to avail ourselves of this survey, thinking it unwise to make a duplicate effort. The termination of our work means that we are without this information. For such extension of training provided by the government as this survey may show as necessary we believe that the Dominion-Provincial Youth Training Plan and the War Emergency Plan offer helpful patterns for the future.

So far as possible people should depend on their own resources in regard to cost and maintenance while being trained. But there will be cases of valuable people who will not be able to do this, and for such people we advocate a system of government loans at low interest.

Finally, we think it should be laid down as a general principle that whatever training it provided for men war workers should be provided for women workers upon precisely the same basis, though dealing with occupations attractive to women or those in which employers like to employ women.

D. Occupations: Professional, Vocational and Special

A detailed and subdivided classification of occupations of women runs into several thousand items and has no place in this report. A summary list of professional and vocational occupations which offer opportunities for women is, however, appended hereto, as it may form the basis for compilation of information to be made available by the government to National Selective Service officers, to personnel women in industry and business, and to all women and girls wishing to know something about possible opportunities. Some occupations offering special opportunity are discussed below:—

University Positions. There is a limited field for women as instructors, lecturers, professors, in academic faculties. There is more scope in professional schools such as household science, library, music, etc., and in extension departments for adult education.

School Teaching. There will be a large demand for qualified women in elementary and high schools to meet the regular annual increase, to fill vacancies, and to replace some thousands of temporary teachers now holding provisional licences in order to meet the emergency. There will be increased demand for specialists, particularly in household science and gradually in nursery school work.

Rural Advisers. There should be openings for women trained as advisers to rural women in special agricultural endeavours, such as bee-keeping, poultry, cheese, fur farming, handicrafts, etc. There should also be women trained to give leadership in rural areas in dramatics, art and musical festivals. While

the agricultural advisers might be sponsored by the Department of Agriculture in each province, the provincial departments of Education should provide the leadership in the arts.

Nursing. Fully trained registered nurses will be needed in increasing numbers in the post-war world, especially as measures of social security are brought into operation. Registered nurses with postgraduate training in hospital administration, in the supervision and training of nurses, and in public health, will be needed in far greater numbers than are at present available.

Trained Attendants. Trained attendants will always be needed to help in homes where the special skill of a trained nurse is not required, but where there is need of efficient and understanding care. The Canadian Nurses Association has set standards for such training.

Rural Nurse Midwives. Special courses designed to train nurses in midwifery and infant care should be established and prenatal and infant care centres should be maintained in widespread rural areas. Whether national Health Insurance legislation be passed and implemented soon or late, this particular need should be provided for without delay.

Physiotherapy, Psychiatry, Occupational Therapy. Young women with suitable qualifications should be encouraged to train in these fields as the demand now exceeds the supply and women in these professions will be very much needed in the post-war world.

Dietitians. The emphasis upon the basic importance of nutrition in maintaining the health of the nation means that dietitians will be in greater demand than at any previous time.

Housing. In a properly organized program of public housing, (low rental projects) there should be an important place for estate managers, assistant managers, resident advisers on household management, and day nursery attendants.

Librarians. There is an increasing demand for women trained for this work to staff public libraries, and government, educational, business and industrial libraries.

Personnel. The need for women in this rapidly growing profession is so great that a section elsewhere is devoted to this.

Social Work. There is a shortage now throughout Canada of trained social workers and the demand will be even greater in the post-war period, in such important work as family welfare, Children's Aid, group work, industrial welfare, police work and in an almost untouched field in many parts of the country, namely, supervision and follow-up work in backward rural districts.

E. Special Problems

It is possible that there may be a problem arising out of the desire of discharged war workers to return to their homes. It will be remembered that these girls were in many cases shepherded by agents of the industries or officers of National Selective Service from their homes into the industries.

In the beginning of the transition period, when there may be a lag in employment during the conversion of industry from war to peace production, it is just possible such workers may require assistance in reaching their homes. The required assistance may be only that of management, but it should be noted that wages appear in many cases larger than they really are in relation to the cost of living. It may be that cheap transportation will be required. We suggest only that some department of Selective Service be giving thought to this problem. It is, of course, desirable that if a girl wishes to do so, it should be possible for her to return to her home.

F. Housing

In making use of the building which apparently will be available at the end of the war we see an opportunity for the establishment of hostels for women workers in large cities. Until a large part of the half-million dwellings which will be needed in Canada at the end of the war has been erected (see Chapter 6, Report of Subcommittee on Housing and Community Planning), and probably after, the problem of the housing of the single woman worker will continue to be a difficult one. The lives of such women would be made pleasanter, and their work thereby more efficient, if good housing conditions could be provided. This provision is all the more necessary since a system of part-time household workers will create a large group requiring accommodation.

G. Social Security

Under the Unemployment Insurance Act certain large groups of single women are omitted, in particular, nurses, teachers, social workers and permanent civil servants. We are informed that nurses, teachers and social workers have expressed their desire to be included under the provisions of the Act, and this Committee recommends that these three groups should be brought under the operation of the Act and also urge that every consideration be given to the inclusion of the household worker under this Act.

We also recommend that the Workmen's Compensation Act should be broadened to include more groups of women workers.

Most of the social security measures are of great value to the single woman earning her own living, and we would particularly emphasize the desirability of a contributory old age pension, and of disability pensions.

There is one problem in relation to the security of the single woman which we see clearly, but to which we have not been able to give any study. Statistics show that the employment of single women drops rapidly once they have reached the age of 40. The single woman of over 40, therefore, is to a steadily greater degree insecure in regard to her future.

VI. GROUP 3. MARRIED WOMEN WORKING OUTSIDE THE HOME

This is a comparatively small group. In the last ten years, out of between nine and ten women workers one has been a married woman. It was not until 1942, when the demands of war industry began to be felt, that the picture changed, and now slightly more than one out of every four women workers is married.

The woman in this category fills the dual functions of the woman in the home and the single woman earning her own living. It follows that she needs practically all of what has been suggested in Groups 1 and 2.

Even more important is the need for the recognition of her right to work at whatever employment she chooses, provided, of course, she is qualified for that employment. This right has always been conceded to workers in the lower economic ranks, such as laundresses and charwomen. It is only when we come into the ranks of the better-paid women that the weight of public opinion creates difficulties for her, as for example, in the teaching profession where in our judgment the married teacher would really be of great value.

There are two points worthy of note about married women's work. The first is that many employers have expressed the opinion that she is a better worker than the single woman in the sense that she has greater steadiness, resourcefulness and more sense of responsibility; this, in spite of the fact that her average absenteeism may be somewhat higher due to home emergencies. The second is that it is the married women who are so largely filling the part-time jobs in our war economy. This may be taken as an indication of the role they will play in peacetime. Part-time employment on a large scale may be a menace to the regular full-time worker, except in a time of full employment. But given full employment a valuable service can be rendered in many fields on a part-time basis by women in the home needing or desiring to supplement their income.

VII. GROUP 4. PROBLEMS OF FARM WOMEN

A. General Factors

The position of women on farms and in rural communities is, and will remain, so long as Canada is based upon an agricultural economy, one of first importance to all the women of the country. Under present conditions young women are leaving the farms and the older women are bearing intolerable burdens. Some way must be found to make rural life less arduous and more attractive to women. We recognize that the economic status of agriculture is in large measure responsible for the conditions that prevail on the farm and in the farm home. Since another Subcommittee of the Advisory Committee on Reconstruction has been working on agricultural economies, we confine ourselves in this report to a recognition of its importance and omit this field of enquiry. It is obvious, however, that farm life cannot continue without farm homes and that conditions must be such as to make women willing to create these homes.

This problem is of prime importance because the movement of women from the farms into war work, direct or indirect, is one of the largest. It is, indeed, the only movement about which we have been able to get precise figures. The records show that just under 100,000 women have gone from the farms into work caused by the war. Farm life, therefore, offers one of the largest fields open to women when war work ceases, and both because of this, and because of the fundamental needs of the country, every possible effort to improve the conditions under which life is lived in farm homes is essential.

With reference to the latter aspect, the Subcommittee recognizes the vital part agriculture must continue to play in the national economy by reason of the fact that Canada is one of the great food producing countries of the world. The recent world food conference at Hot Springs, Virginia, emphasized the tremendous importance of food in the post-war era as a major factor in building a secure and peaceful world. In connection with food requirements it is significant to note that the Canadian people themselves have not yet reached desirable nutritional standards. According to Dr. L. E. Kirk, Dean of Agriculture, University of Saskatchewan, in an address to the Canadian Society of Technical Agriculturists, to achieve this objective for urban dwellers alone would require an increase of 30 per cent more milk or 1,600,000 quarts per day, 25 per cent more eggs, 18 per cent more meat and 75 per cent more fruits and vegetables.

Nor is the need for farm production confined to the nutritional field. Increased industrial utilization of farm products in the comparatively new science of chemurgy calls for greatly increased agricultural production to supply the necessary raw materials for the manufacture of synthetics.

We recognize that farm production, as well as the maintenance of farm life, is bound up in a special sense with the work of women on the farm.

B. Special Needs of Farm Women

As a homemaker the woman on the farm plays the same role as a homemaker in the city. In this aspect she is included in Group 1, and all the measures recommended in that section are necessary for her insofar as they are, or may be made, applicable to life on the farm.

The woman on the farm, however, has special problems due to the fact that she is a homemaker engaged in productive work. We, therefore, consider in this section her special needs with respect to her work in the home and on the farm.

1. Electrification of the Farm Home.

It is the considered opinion of the Subcommittee that the use of electrical power is the greatest single factor in the elimination of laborious tasks which necessarily form part of the routine of rural women's work. For example, to

refer to only three constantly recurring tasks, sheer drudgery as such disappears through the use of electrical power for cream separators, churns, and power-washers to take care of the heavy, grimy, weekly accumulation of laundry not only of the farm family but of all the hired labor employed in the farm unit. The consequent release of energy and time for cultural and social interests and activities is inestimable.

Electric lighting in the farm home raises the standard of life on the farm as it does in the urban home. Further, it has been amply demonstrated that electricity means increased returns to the farmer and his wife, thereby improving the general farm economy. In addition, the intangible benefit of rural electrification through its contribution to the physical and social well-being of the community should be clearly recognized and appreciated.

The Subcommittee desires to emphasize that the devising of way and means whereby the program of rural electrification may be put into general operation is of first interest in any plan of postwar rural development in relation to women on the farm.

Since we understand that the report of the Subcommittee on Agricultural Policy deals at some length with this project, we confine our emphasis to one point only. This point concerns provision of appliances for domestic use. It is clear that an increase in the use of electricity will come from an increase in the number of electrical appliances in general use in the farm home, and thus the return on the cost of distribution will be increased. At the present time the cost of these appliances in Canada is high, especially as compared to farm incomes. We suggest that the Government consider adopting certain plans used in the rural electrification administrations of the United States and take action in whatever form may be most suitable to Canada, to secure for farm use a plentiful supply of domestic appliances at, or near, cost.

2. Water Supply.

Second only to the need for electricity, is the need for a plentiful supply of running water. We recognize this is an even more difficult problem than electrification, but consider it fundamental.

The availability of water largely determines the standard in any home. Tables already published by the Dominion Bureau of Statistics from the census of 1941, in Census Bulletin C 4, show that the number of farmers who have been able to have the amenities common to any city home is distressingly low. The problem of farm sanitation is crying out for expert attention.

3. Communications.

Telephones and good roads are still needed in many areas.

4. Housing.

We recognize housing to be an outstanding problem and urge that particular attention be given to the rural section of the Report of the Subcommittee on Housing and Community Planning.

5. Health Service.

As we have already pointed out in our first report, the establishment of adequate health service in rural areas is a matter of real urgency.

6. Education.

If people are to be kept on farms it must be made possible for farmers to give their children an education which has an equivalent value to that afforded the children of urban parents. Particularly it is recommended that effort be made to train teachers and school nurses definitely for work in rural areas.

Another problem requiring attention is that of irregular attendance. It is our feeling that definite encouragement should be given to the extension of consolidated schools as recommended in the Report of the Survey Committee of the Canada-Newfoundland Education Association. The fact that for these consolidated schools the transportation of the pupils is arranged should aid in increasing attendance.

7. *Adult Education and Recreation.*

There is need for the extension of opportunities for recreation and cultural activities, as recommended in the reports of the Subcommittees on Agricultural Policy and on Publicly Financed Construction Projects.

8. *Remunerative Enterprises.*

In order to attract energetic young women back to the farms it appears to us necessary that remunerative enterprises which they can undertake as a source of personal income, are of importance. Small businesses could be encouraged by the Department of Agriculture through the establishment of a service of trained expert advisers, and by a supply of information pamphlets carefully and skilfully compiled.

Upon advice of farm women we append the following list:—

(a) Remunerative enterprises attached to and in connection with the farm that may be undertaken by women in rural areas:

- Poultry raising,
- Dairying,
- Apiculture,
- Fur farming,
- Small fruits farming,
- Fruit and vegetable canning,
- Mushroom culture,
- Flower and bulb culture,
- Medicinal herb growing,
- Pure seed production,
- Growing vegetables for dehydration,
- Handicrafts.

(b) Enterprises that may be linked with the farm in suitable areas:

- Tea-rooms and restaurants
- Rest homes for convalescents
- Vacation homes.

9. *Co-operatives.*

There is definite need for the encouragement by the Government of small co-operative enterprises, by means of expert advice, an educational program, and financial assistance where necessary.

VIII. OTHER RECOMMENDATIONS

1. *Unemployment Insurance.*

In its study of unemployment insurance the Subcommittee came upon the fact that there were in the four lowest categories of those insured about 500,000 persons whose benefits under the scheme would not amount to a bare subsistence minimum. There is a public belief that any insured person is safe for a time, that time depending on how many weeks' benefit he has earned. We were, therefore, anxious to find out who the workers in this category were and if possible to find out whether part-time work or low wages were the cause, and

how many women were affected. It has proved impossible to get precisely the figures we wanted but certain facts have been brought to light which ought to have serious consideration.

In Unemployment Insurance figures for the 1941-42 period 705,000 women were registered. In this total is included a group of 172,900 earning less than \$12 a week. It should be remembered that women in the domestic service category do not come under minimum wage laws, or under the Unemployment Insurance scheme so their wages are not affecting this result.

Analysing this group of 172,900 we find that within the group are 74,300 girls who were under 19 years of age. This means that there are 98,600, or the difference between 172,900 and 74,300, employed insured women who are earning an extremely low wage which affords very slight insurance protection. This is a distressing situation which ought to be examined with more care than we have time for, as we were not able to get the figures until our last meeting.

2. *Child Labour.*

Reports have reached the Committee from many sources concerning the increasing number of child workers in Canada. We wish to place on record our strong opposition to permitting any Canadian child to enter full employment while still of school age. We cannot but feel that this is injurious to the home, and is a factor in the increase of juvenile delinquency and the spread of tuberculosis.

The school-leaving age is not at the same year in all parts of Canada, but we would urge the enactment as fast as possible of compulsory school attendance acts up to the age of 16, and the forbidding of any full-time employment below that age. This would be an advance in Canada, but such an advance ought to be coupled with an effort to carry on the education of the young worker after the age of 16.

3. *Artists.*

We recommend that employment and encouragement be given to the artists of Canada, both men and women, by allotting to them, for the beautification of public buildings, a small proportion of the public funds which are to be used to erect these buildings. Thus by sculpture and by murals and other paintings there will be an enrichment of cultural life in Canada, and a stimulus towards a more truly Canadian art.

We note with approval that the Report on Publicly Financed Construction Projects draws the attention of the Government to the Work Projects Administration schemes for artists in the United States, which has been in operation with remarkably fine results during the last ten or more years. Now is the time for Canada to adopt an equally enlightened and far-sighted policy in connection with the post-war construction program.

4. *Architecture and Interior Decorating.*

We suggest that women trained in these professional and vocational fields be placed on boards and committees entrusted by the Government with housing projects, and with construction of hospitals, convalescent homes, community halls and other buildings.

5. *Change of Census Classification Title.*

We urge that the category "Domestic Service" be removed from the census and the title "Household Workers" be put in its place. We think that this will help in raising the status of the occupation.

SUMMARY OF PRINCIPAL RECOMMENDATIONS

1. Immediate preparations to increase employment opportunities for women.
2. The implementation by the Government of a new plan for raising the status of household work and household workers.
3. The establishment of a scheme of children's allowances.
4. The speedy implementation of health insurance.
5. Particular attention to be given in any housing scheme to adequate household conveniences for doing the work of the home.
6. The extension of nursery schools.
7. Encouragement of National Selective Service in securing a highly trained staff.
8. Selection from among those now employed of well-educated, capable young women who would like to be trained to fill an imperative need for technical and professional workers in the post-war period.
9. Training or retraining for transition period. Government should provide, or supervise the training. The young women to be trained should provide their own maintenance but loans at low interest or scholarships might be offered from government sources.
10. Extension of Unemployment Insurance and Workmen's Compensation Acts to include groups of women not now included.
11. Immediate attention to the special needs of farm women.
12. Immediate and serious attention to the problem of the 100,000 women over the age of 20 working for less than \$12 a week in occupations covered by unemployment insurance.

APPENDIX A

Some Occupations for Women

I. Professional:—

1. Education—University
School
Physical Training
Music
Household Science
Dramatics
Art
Agricultural Advisers
Handicrafts
Vocational
Nursery School
2. Medicine
3. Dentistry
4. Nursing — Hospital
Private Duty
Public Health
V. O. N.
Rural Midwifery and Infant Care
5. Physiotherapy
6. Psychiatry
7. Occupational Therapy
8. Dietitian
9. Librarian
10. Law
11. Accountancy
12. Theology
13. Engineering
14. Architecture
15. Horticulture
16. Social Work
17. Veterinary
18. European Relief and Reconstruction Work
19. Music
20. Art
21. Drama
22. Personnel Administration

II. Vocational:—

1. Business—Executive and Secretarial
2. Dressmaking
3. Millinery
4. Cooking

II. Vocational:—*Concluded*

- 5. Commercial Art
- 6. Interior Decorating
- 7. Research Assistants for Instrument Testing and Research Laboratories
- 8. Laboratory Technicians for Hospital Laboratories, Government and Municipal Public Health Laboratories
- 9. Journalism
- 10. Practical Nursing
- 11. Hairdressing and Personal Services
- 12. Trained Household Work
- 13. Salesmanship—Retail Stores, Insurance

III. Specialized Work:—

- 1. Telephone Operator and Other Communications Jobs
- 2. Printing and Teletype
- 3. Photography
- 4. Dyeing, Cleaning and Pressing, and Laundry
- 5. Personnel Supervisors
- 6. Buyer and Shopping Service
- 7. Advertising
- 8. Airways' Stewardess
- 9. Ship's Stewardess
- 10. Hotel Hostess, Cafe Manager, Waitress

IV. Clerical and Secretarial:—

- 1. Civil Service
- 2. Banks
- 3. Municipal Offices
- 4. Business and Private Offices

V. Administrative and Executive Work.

Many fields from diplomatic corps to business.

APPENDIX B

Social Security Proposals

First Report of the Subcommittee, May, 1943

When your Subcommittee on Post-War Problems of Women was set up early in this year, the Chairman of the Advisory Committee on Reconstruction, Dr. James, requested that, before going into the work assigned to the Subcommittee by the terms of reference, the Subcommittee should make a report on social security in relation to women. This report is now submitted.

Between the time when the request was made and the Subcommittee was organized for work, the Marsh Report had been referred to the parliamentary Committee on Social Security. This being the case, your Subcommittee felt that it was not required to cover again the history and the development of the principles underlying the insurance and allowances included in the system of social security suggested for Canada. In general, it is in accord with the principles set out in the Marsh Report and concurs in the reasons advanced in support of the principles. In the mind of the Subcommittee, its report is an addendum to the Marsh Report.

Before coming to the particular question of social security in relation to women, the Subcommittee would, however, like to make clear its general position on the whole matter of social security. It supports firmly the belief referred to in the Speech from the Throne at the opening of the present session of parliament on January 28th last: "My ministers believe that a comprehensive national scheme of social insurance should be worked out at once, which will constitute a charter of social security for the whole of Canada."

It further concurs in the statement of the Prime Minister, made to the House on March 3rd last, in introducing the motion for the appointment of a special committee on national social insurance:

May I interject that any system of social security is based on the theory that all industry is, or ought to be, in the nature of social service; that industry is not merely a means whereby capitalists may increase profits, or workers find the means of gaining a livelihood through wages; but that there exists also the right of the community, which makes possible the carrying on of industry, to expect to have the interest and well-being of the community and its members considered in the rewards of industry. In other words, industry exists to serve a social end as well as to serve the needs of individuals. Under that view men and women are the great asset of the state. The well-being of all the human resources, the men and women who supply the labour, and the thought and skill essential for planning and carrying on industry ought to be the first concern of the state. And where the state makes possible the carrying on of industry, they are entitled to have the state see that they are protected against inevitable hazards.

The Subcommittee takes as its foundation this statement from the Marsh Report: "It is the first purpose of social security to offer a social minimum—a floor to poverty."

The Subcommittee is anxious to see a social insurance scheme of broad scope introduced at the earliest possible time and stresses the importance of a unity of design which will allow for the orderly incorporation in a coherent system of schemes already in effect, as well as of schemes to be initiated.

The Subcommittee also recommends the supplementing of such a system by non-contributory allowances and discretionary grants to give protection to those not covered by an incomplete program or who may be better cared for by a system of allowances and grants. In saying this, the Subcommittee wishes it to be understood that it supports the system of contributory insurance in general, in order that there may be full co-operation between the state and the individual.

It was not, however, a report on the whole matter of social security that the Subcommittee was asked to prepare, but rather on social security in relation to women. It appears to the members of your Subcommittee that there is no form of social security which does not affect both men and women. The wife suffers at once if her husband be unemployed, ill, or disabled. The father and mother are both affected by the gain or loss of children's allowances. The life of a man is relieved of a continuing and deep-seated worry by the existence of widows' pensions or allowance. Funeral expenses benefit the survivor whether the survivor be a man or woman.

Because of this belief, the Subcommittee has made a study of each of the insurances and allowances, and has endeavoured to consider the relation of each category to women. There are, in its opinion, only two cases which appear to relate primarily to women, though when looked at carefully, they concern the husband as directly as the wife. These two cases are:

- (a) The widows' pension or allowance.
- (b) The special provision for employed women in the weeks before and after childbirth.

General Recommendations

1. As an approach to the result of our study and discussion, the members of the Subcommittee desire to put on record their definite support of the "two-person-unit" as proposed by Sir William Beveridge, and advocated in the Marsh Report. The following quotation from Sir William Beveridge, though written for Great Britain, appears to the Subcommittee equally applicable to Canada:—

"In any measure of social policy, in which regard is had to facts, the great majority of married women must be regarded as occupied on work which is vital, though unpaid, without which their husbands could not do their paid work, and without which the nation could not continue.

In accordance with facts the plan for social security treats married women as a special insurance class of occupied persons and treats man and wife as a team . . . It reserves the description of "adult dependent" for one who is dependent on an insured person but is not the wife of that person. It treats a man's contribution as made on behalf of himself and his wife as for a team, each of whose partners is equally essential and it gives benefits as for the team."

This quotation might perhaps be made even stronger for this country, since Canada has proportionately a larger agricultural population. In this occupation, wives are directly contributing to and actually sharing the husband's occupation, while among urban wives, the function is rather that of managing, housekeeping, caring for the well-being of the family, and saving. Your Subcommittee has given special thought to the problem of women among the rural population. This is perhaps the place to state its belief that much thought and care should be given to the inclusion of the farming population in the social security program. Everything possible should be done to simplify its administration in order to make it easy for the rural population to enjoy to the full the benefits of health insurance, children's allowances, and contributory old-age pensions, the three measures particularly applicable to the whole population, rural as well as urban.

2. Your Subcommittee believes that, where there are well developed provincial departments in the fields of health and public welfare, these provincial departments might well be entrusted with much of the administration of social security measures. It wishes to point out that with regard to any insurances and benefits, allowances and grants in the social security program which may be thus administered by the provinces, it is of prime importance that the federal government stipulate minimum standards of administration, supervision, and rates of payment in order to secure a national minimum standard. The provinces should, of course, be left free to improve upon this minimum if they so desire.

3. In the case of all non-contributory benefits where the province requires the recipient to establish residence, it is of the utmost importance that a federal department be maintained to handle the cases of "citizens-at-large", i.e. citizens who through no fault of their own, in most cases, cannot meet the proof of residence requirements and are therefore not eligible under any provincial set-up. The totally unjustifiable hardships which such citizens have suffered in the past would in this way be obviated.

4. Although it may seem obvious that the administrative system should include provisions as in the last two paragraphs, the Subcommittee wishes further to state its belief that it is important that there should be somewhere in the system of administration a power of giving some flexibility to the conditions applying to any of the social security measures. As a good example in relation to non-contributory allowances or grants, there is the system set up for the administration of dependents' allowances. It is one where this power, definitely given to the voluntary boards, permits of variation to suit the problems of particular cases. Some such authority should be vested in a high official in the case of insurances and benefits. It should not be made possible, however, to permit a lowering of the federal minimum. While human problems fall into patterns, the patterns are never precisely the same and an undue hardship may arise from too rigid a system of administration.

5. At many points in the Marsh Report, the matter of the desirability and the urgency of training of personnel is referred to. The Subcommittee endorses all that is said in the report regarding this matter. It is the definite belief of the members that, in order that social insurance and security measures may be carried out in the best interests of the entire community, it is imperative that immediate steps be taken to train the necessary personnel for social understanding and effective administration. It is suggested that candidates for the training might be secured in some numbers from among the groups of young women graduating from the universities if training courses were immediately available. It is also suggested that provisional training might be provided through institutes set up in cities where help in this training might be given by those experienced in social and administrative work in the community. This would not be the ideal training, but, if the schools of social work cannot take care of any more students, such training might serve as an introduction to practical work, and would be a training which could later be amplified in the schools.

Recommendations on Particular Measures

As has already been stated, the members of the Subcommittee agree generally with the reasons for the various insurances, benefits, grants and allowances as set out in the Marsh Report. Therefore, in recording the conclusions they have reached unanimously, a brief statement of the conclusions only is given here.

1. Health Insurance

Health Insurance is strongly supported in principle because:—

(a) Where there is not unemployment, sickness is much the greatest single cause of poverty and need.

(b) Adequate medical care is a basic need of everyone in the population, rural or urban, wage-earner or non-wage-earner.

(c) If carefully organized, health insurance affords a basis on which the other social insurances can be built.

(d) Health insurance tends to place emphasis upon preventive measures, sanitation and public health and on youth and child physical fitness, thus raising the standard of health of the entire population.

It is the Subcommittee's conviction that health insurance should precede the other insurances not yet established in Canada, that it should be compulsory and all-inclusive, with at least token registration payments for the group unable to make the continued financial contributions, as in the New Zealand plan. Here again, attention is called to the urgent present need for an energetic government training scheme for staffing maternity and infant welfare clinics in rural districts, and for trained nurse midwives.

2. Children's Allowances

(a) The Subcommittee strongly supports introduction of a system of children's allowances and hopes that the establishment of this system will follow health insurance as soon as possible. It is the only system yet devised which will remove the poverty arising from the fact that a man's wage must be based on the product of a man's labour and not on the size of his family. The Subcommittee believes that these allowances should apply to all families with children.

(b) The Subcommittee would like to see adequate allowances, but believes it to be of first importance to get the principle established and, therefore, would be willing to support in the beginning a smaller allowance than would be adequate to achieve the full purpose—health, proper food and clothing, education, and desirable conditions of family life for the children. These allowances, which will necessarily be non-contributory and be paid from the national treasury, should be on a graduated scale, increasing with the age of the child, and should be paid to the mother, or to the authorized guardian taking the place of the mother.

(c) Should it prove to be the fact that the economic burden of children's allowances is too great, if applied to all children, the Subcommittee, with one exception, feels that, on an experimental basis, the allowances should be paid for children up to the number of six, just as is done in the case of allowances made to mothers whose husbands are serving with the armed forces.

(d) It is suggested that the administration of these allowances will have to include some supervision in cases where it may be necessary because of the incompetence or unwillingness of the mother to use the allowances for the purposes for which they are given. Experience has already shown in relation to cash relief and to dependents' allowances that these cases will be few. This supervision could remain in the provincial departments of welfare where these departments are in wide-spread operation. The co-operation of the school teacher and public health, school or rural nurse should be sought in checking up on this matter.

(e) The Subcommittee calls attention to the fact that since the income tax clause relating to exemptions for children was changed a year ago, there has actually been a system of children's allowances in Canada for all families

where the father is in receipt of an earned income of approximately \$1,600.00 or over. Thus, children's allowances are, in effect, now being paid to those best able to do without them and withheld from children of the families of the lower income group. When the system of children's allowances comes into effect the income tax exemption should be discontinued and any discrimination disappear.

(f) Finally, particularly in relation to children's allowances, the Subcommittee suggests that an educational program on the subject of these allowances should be undertaken at once, as it believes the public generally is unfamiliar with the idea of children's allowances and the benefits which will be derived from such a system.

3. Other Insurances

Other insurances or benefits proposed in the Marsh Report have the support of the Subcommittee as contributing to the health, happiness, efficiency and security of the family unit, or of the individual worker. These being all contributory will come as of right; thus they will at once encourage thrift and remove some of the worst fears which beset family life. These include contributory old-age pensions, sickness benefits and disability pensions, maternity benefits, widows' pensions, survivors' pensions, and funeral benefits. All of these insurances and benefits have the support of the Subcommittee as extensions of the system of social security.

4. Allowances

Until a full system of social security is in operation, and perhaps even beyond that point, certain allowances will, in the opinion of the Subcommittee, be essential. Concerning these, it wishes to offer some suggestions.

(1) Maternity Grants

The first suggestions which the Subcommittee wishes to offer may be looked at in the light of an extension of the maternity benefit paid to the employed women. It is that a maternity grant might be made to the wives of men engaged in farm work. This is a group whose welfare should be considered and there is an inequity in providing a maternity grant for working women and not for a farmer's wife. Obviously, an insurance scheme for this would, at any rate until social security is highly developed, be too difficult and costly to be practical. This payment from the state to the farmers' wives, therefore, might be considered as one of the results of the fact that life in Canada is still based largely on an agricultural economy, and that the systems of security as developed so far, appear to deal more with countries having, as in the case of Britain, an urban economy. Such a grant would, moreover, be a compensating advantage for the inability to share in the insurances provided for urban workers, and would be justified by the fact that farmers' wives do actually share the occupation of their husbands.

(2) Mothers' Allowances

It is recognized that with the institution of children's allowances, the need for the present provincial systems of mothers' allowances will largely cease. Your Subcommittee, however, does not approve of the idea suggested in the Marsh Report that the widowed mother receiving children's allowances should be cared for through the medium of public assistance.

(a) It is suggested that, when children's allowances are adopted, a guardianship grant on a non-contributory basis should be paid to the mother or other authorized guardian, if the father is dead or totally incapacitated. It is

believed that guardianship care will always be required and that the guardian, whether the mother or another person, an organization, or a government department, should be paid for the service. The use of this type of grant would afford room for variation, based on administration according to individual circumstances. Attention is called to the fact that when survivors' benefits or contributory widows' pensions are fully implemented, such a grant will only rarely be required.

(b) The problem of the maintenance of the unmarried mothers of children receiving children's allowances is one to which very careful thought must be given and one on which the Subcommittee has not yet formulated a unanimous recommendation, but a majority opinion would favour guardianship allowance to the mother in those cases where the Children's Aid or other proper authority so recommends. It is in agreement that the child born out of wedlock is entitled to equal treatment with that of other children, in the matter of children's allowances, under an approved guardianship.

(3) Widows' Allowances

Until such time as widows' pensions or survivors' pensions are in force the subcommittee believes that there is a general case for widows' grants and in some particular cases for allowances. The widows' grant would be a moderate temporary allowance designed to meet the situation when the family income suddenly ceases. It would be paid only for the period of time required for the adjustment of family circumstances. This period might be six months and should not exceed one year.

It is assumed that where there are children under 16 receiving allowances, the mother will usually be the guardian and as such will receive the guardian's payment. If her time is not required in caring for her family, or if she is a widow with independent adult children, or with no children, and she is employable, she should be given retraining, provision for this being made in the retraining schemes which it is suggested shall be established under the employment service of Canada. This would involve a training allowance in some form. If this desirable procedure is to be possible, special study must be given at an early date to the kind of occupations which may be suitable for such persons, to the staff required for organizing such training, the methods of assisting placement, and like matters which must be organized as a special unit under the Dominion Employment Service.

Only when the widow ceases to be the guardian of her children, and cannot be trained for employment, will the case for a widow's allowance arise. Until such time as widows' pensions, on a contributory basis, are established, it would appear that widows' allowances, on a non-contributory basis, might be necessary until the widow reaches the age entitling her to the old-age pension.

5. The Unmarried Wage-earner with Adult Dependents.

There is one situation arising among both men and women wage-earners which is not yet taken care of in any way, and which should not, in the Subcommittee's opinion, be left to public assistance. This is the case of the unmarried wage-earner, man or woman, supporting adult dependents, usually a parent or parents. Surveys have shown that quite a considerable proportion of employed women are in this position.

The most careful of these surveys is one made for the International Labour Office by a committee representing thirteen organizations of women wage-earners in Canada. It reports results as follows in percentage:—

1. Women wage-earners who are the sole support of dependents, 22 per cent.

2. Women wage-earners who have no responsibility other than their own maintenance, 15 per cent.
3. Women wage-earners who have financial responsibility other than their own maintenance, 63 per cent.

It is a difficult case for a woman since her salary is usually within a scale which will provide for herself only. It is also difficult for men workers since it is frequently necessary for them to employ some one to care for the dependent.

The Subcommittee suggests that, subject to strict definition of the dependency, it would be possible to meet the situation by making the first dependent as the partner in the two-person-unit in those insurances where this partnership idea applies. It is probable that, when all the proposed measures are implemented, the dependents in these cases will be provided for in one way or other. In the meantime, the single wage-earner is subject to a burden which appears to be alleviated in the case of the married wage-earner.

For Further Consideration

1. Unemployment Insurance.

This part of the proposed system of social security now in force in Canada appears to the Subcommittee to be intimately related to its main work—the post-war problems of women—that it is left for further consideration and treatment in a later report.

In the meantime, the Subcommittee has asked for a further analysis of some of the figures of the Marsh Report, and of the records of the Unemployment Insurance Commission, in order that the benefit of this insurance to married women and to the woman wage-earner may be more clearly seen.

2. Unemployment Assistance.

Unemployment assistance is so closely tied in with unemployment insurance that it also is left over for further consideration.

The subcommittee wishes, however, to record its hope that, under the development of social security, there will be less and less need for public assistance and quotes with approval from the Marsh Report:—

Unemployment assistance measures in Canada must be designed as constructively as possible in relation to public employment projects, to training and transference programs and to the co-operation of industry in utilizing the service of employment offices.

3. Workmen's Compensation.

The Workmen's Compensation Acts of the various provinces, which provide medical care, benefits and pensions for workers disabled by industrial accidents and certain industrial diseases, apply on the same terms to all workers, men and women alike, in the industries within the scope of the acts. The dependents of such women workers, providing they come within the definitions of "dependents," "member of the family" or other qualifying terms of the acts, receive the same consideration as the dependents of men workers.

The subcommittee has noted this fact concerning women under Workmen's Compensation Acts with great interest and believes that the success which has attended this, Canada's earliest and most successful experiment in social security, offers a good foundation for its belief that any scheme for social security that may be established should be made applicable for men and women alike within the categories covered by any such scheme.

It is obvious that the extent to which workmen's compensation covers groups of women workers has an immediate relation to their security in the post-war

period. Consideration of the possibility or advisability of extensions of the application of these acts, as part of a social security system, is left for a later report.

Conclusion

In conclusion, the Subcommittee wishes to point out that no opinions or suggestions have been made in this report in relation to the technique of contributions or the methods of administration. These are questions of vital import in the success of any social security plan and it has not as yet been possible to give them the detailed study they demand. The Subcommittee has also set up a continuing agenda on which are placed subjects it hopes to study and report upon. These already include housing, nutrition, the Children's Charter, and post-war employment conditions. It is, therefore, as subsequent developments make it appear desirable, prepared to make further reports.

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The Calendar of the Future

By DR. A. VIBERT DOUGLAS, Arts '20, M.Sc. '21.

(Lecturer in Astrophysics, McGill University.)

ASTRONOMERS are invariably interested in questions relating to the passage of time, the practical problem of the recording of the sequence of days and nights, solstices, and equinoxes. The formation of a calendar is essentially an astronomer's task, but since the calendar affects the life and interests of every man, woman, and child, the public should be interested in this question and should not relegate it to a few fanatical hobbyists, or leave it to uninformed political expediency.

Julius Caesar called upon Sosigenes of Alexandria to draw up the Julian Calendar and based his Edict of 45 B.C. upon this astronomer's proposals. Pope Gregory XIII invoked the aid of a Roman astronomer, Clavius, and followed his recommendations in the revised calendar of 1582. Omar Khayyám was both an astronomer and a poet, and it was in the former capacity, not the latter, that he served his day and generation, and many generations following, as a calendar maker, one of a committee of eight appointed by the Sultan of Khorassán in A.D. 1079. The Catholic countries of Europe have been following the Gregorian calendar since its introduction in 1582.

England refrained from calendar reform until 1751. By that time seventeen centuries had elapsed since the introduction of the Julian Calendar with its inadequate Leap Year Rule—inadequate since it had not kept the spring equinox at or near any one calendar date. March 21st had been selected by Pope Gregory. In 1752 the Julian Calendar had moved eleven days ahead of the astronomical year of the seasons (the tropical year, 365.24220 days) and hence of the Gregorian Calendar with its better Leap Year Rule. Something drastic had therefore to be done in England, and a very great calendar upheaval took place, twofold in character. First, in the matter of New Year's Day, which had been March 1st (as in Rome prior to the Caesarian Edict of 45 B.C.), and was, by act of Parliament, 1751, identified with January 1st of that year, which thus became January 1st, 1752. Secondly, to bring the vernal equinox into line with the Gregorian Calendar, eleven days of September were dropped entirely, the 2nd day of September being followed by the 14th. It was, of course, necessary to make legal provision for resulting problems regarding taxes,

rentals, salaries, and so forth; but nothing could be done to stem the tide of ignorant resentment and superstitious anger on the part of some sections of the populace; and serious riots testified to the reality of the impression that the government were by act depriving men of eleven days of their lives. The dogma that the calendar is a divinely established ordinance that must not be tampered with is one that dies hard; indeed it is far from dead now in our own day when the question of calendar reform is once more a live issue.

There are two distinct matters before the nations at the present time, (1) the question of the advisability of fixing the date of Easter, (2) the question of introducing some form of fixed or universal calendar.

The former question has been fully debated in the British Parliament, by various religious bodies, and by the League of Nations committee on calendar reform. Under the present rule for the date of Easter (the first Sunday after the first full moon following the vernal equinox), its position in the calendar can vary as much as 35 days, a most unsatisfactory arrangement for church and state and all mundane affairs. A British Easter Act was passed in 1928 approving the principle of a fixed Easter "on the Sunday following the second Saturday in April" in the Gregorian Calendar. The League of Nations embodied this in their "Easter Act," 1931. It is worth noting that as far back as July 1920, Lord Desborough introduced his bill in the House of Lords basing the selected date in April on the result of researches by Mr. Fotheringham, that the date of the Crucifixion was Friday, April 7, A.D. 30. In 1923, Lord Desborough introduced the subject for discussion at the Congress of International Chambers of Commerce in Rome. A committee was appointed, after the matter was referred to Geneva, representing the Pope, the Ecumenical Patriarch, and the Archbishop of Canterbury, and their conclusions were favourable to the reform. All the nations composing the League were invited to express their views and the replies were almost unanimously in favour of fixation.

So much for the date of Easter, now let us consider the larger problem of the introduction of a perpetual calendar. Among the proposals that have been made, there are two that deserve consideration—the World Calendar (of 12

charcoal in 1323; and in an Arabic manuscript of about the same date an instrument is described, consisting of a hollowed log, whose bore was filled half way from the bottom with a mixture of the same elements, tamped down with a wad. The projectile was a ball, rather larger than the bore, which rested on the upturned muzzle.

The earliest recorded Western gun is almost as fantastic. It is a vase-shaped bombard, and our knowledge of it comes from an illustrated address presented to Edward III in A.D. 1327. In 1346 the first use of field artillery was made by the English at Crecy. Famous cannon of the past include the "Dulle Grete of Gaud" and "Mons Meg," the former a wrought iron gun, constructed about A.D. 1400, weighing 13 tons, with a bore of 25 inches in diameter, and capable of firing a stone projectile weighing 700 pounds; and the latter, now one of the notable sights of Edinburgh Castle, with a bore of 20 inches and capable of firing a projectile weighing 350 pounds. Even more powerful guns, with a bore supposed to have been as much as 48 inches and a projectile weighing 2200 pounds are reported to have been used by Mahomet II in A.D. 1453 at the siege of Constantinople.

Whether the bore of Mahomet's guns was as great as these reports suggest, or whether the

more modest estimate of 36 inches found in other contemporary accounts is closer to the truth, there is no doubt that his weapons were instrumental in bringing about the capture of what was at that time the most perfect and elaborate fortress in Christendom, and which in repeated attacks had shown itself impregnable to the earlier weapons of siege warfare.

If space permitted, I should like to trace the development of artillery and fire-arms down to the period of the Great War, note the influence of these arms on tactics and war organization, and record their reactions on the fate of empires and of peoples. But the evolution was so gradual that too much space would be required to follow it in any detail. And due to its very gradualness, it is more or less true that down to the opening of the Great War in 1914 a substantial equality in weapon types existed in all the great armies of the world.

This continued stability in the major weapons and the fact that the rifle through mass production became a weapon simple to operate and of no great cost, led to the overwhelming importance of numbers. The railroad permitted their employment, and the building and control of strategic lines became an element in the incessant struggle

(Continued on Page 35)



CROSSING A RIVER

Tanks that can cross a river are among the armament developments in the years since the Great War. The light tank here shown is similar to the one shown in another illustration while operating on land.

JANUARY							APRIL							JULY							OCTOBER						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
8	9	10	11	12	13	14	8	9	10	11	12	13	14	8	9	10	11	12	13	14	8	9	10	11	12	13	14
15	16	17	18	19	20	21	15	16	17	18	19	20	21	15	16	17	18	19	20	21	15	16	17	18	19	20	21
22	23	24	25	26	27	28	22	23	24	25	26	27	28	22	23	24	25	26	27	28	22	23	24	25	26	27	28
29	30	31	...	...	...	...	29	30	31	...	...	...	...	29	30	31	...	...	...	...	29	30	31	...	...	...	...

FEBRUARY							MAY							AUGUST							NOVEMBER						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
...	...	...	1	2	3	4	...	...	...	1	2	3	4	...	...	...	1	2	3	4	...	...	...	1	2	3	4
5	6	7	8	9	10	11	5	6	7	8	9	10	11	5	6	7	8	9	10	11	5	6	7	8	9	10	11
12	13	14	15	16	17	18	12	13	14	15	16	17	18	12	13	14	15	16	17	18	12	13	14	15	16	17	18
19	20	21	22	23	24	25	19	20	21	22	23	24	25	19	20	21	22	23	24	25	19	20	21	22	23	24	25
26	27	28	29	30	...	...	26	27	28	29	30	...	...	26	27	28	29	30	...	...	26	27	28	29	30	...	...

MARCH							JUNE							SEPTEMBER							DECEMBER						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
...	...	...	...	...	1	2	...	...	...	...	1	2	...	...	...	...	1	2	...	...	...	...	1	2			
3	4	5	6	7	8	9	3	4	5	6	7	8	9	3	4	5	6	7	8	9	3	4	5	6	7	8	9
10	11	12	13	14	15	16	10	11	12	13	14	15	16	10	11	12	13	14	15	16	10	11	12	13	14	15	16
17	18	19	20	21	22	23	17	18	19	20	21	22	23	17	18	19	20	21	22	23	17	18	19	20	21	22	23
24	25	26	27	28	29	30	24	25	26	27	28	29	30	24	25	26	27	28	29	30	24	25	26	27	28	29	30

YEAR-DAY, December Y, follows December 30th every year
 LEAP-DAY, June L, follows June 30th in leap years

THE WORLD CALENDAR: EVERY YEAR THE SAME

This shows the calendar of the future as it will appear if the plans of its sponsors are accepted. In the accompanying article, Dr. Douglas describes the advantages that its adoption would bring.

months, four exactly equal quarters), and the International Fixed Calendar (of 13 identical months).

The initiative of Moses B. Cotsworth, backed by the support of the late George B. Eastman, has succeeded in giving a certain publicity to the latter proposal, and an International Fixed Calendar League exists. In this system the year consists of 13 months of 28 days each. The first day of each month is a Sunday, and the last a Saturday. The 365th day is inserted as an extra Saturday, unnumbered, following Saturday, December 28th. In Leap Years, another unnumbered day must be inserted, making a double Saturday in the middle of the seventh month or at the end of the sixth month. The chief simplification of this proposal is in the perpetual agreement of week-day and month dates—for example, Tuesdays can only be the 3rd, 10th, 17th or 24th of every month. The chief disadvantages, and to many people sufficient causes for total rejection of this scheme, are the introduction of a new month (the name of Sol has been suggested for the seventh month comprising the last two weeks of our present June and first two weeks of July), and the fact that a 13-month year is not naturally divisible into half and quarter years.

The World Calendar, or 12-Month Perpetual Calendar, divides the 364 days of the year into four equal quarters, with 31, 30, and 30 days per month. Thus January, April, July, and October will always have 31 days, and begin on a Sunday; February, May, August, and November will have 30 days beginning always on a Wednesday; while the third month of each quarter, March, June, September, December will have 30 days commencing always on a Friday. The 365th day will be called Year Day and be inserted between Saturday, December 30th and Sunday, January 1st. In Leap Years a similar extra Saturday, so to speak, called perhaps Leap Day will follow Saturday, June 30th and precede Sunday, July 1st. This scheme has the advantage from the point of view of business, industry, accounts, and statistics that each month always contains the same number of work-days, so that both monthly reports and quarterly reports are unequivocally comparable, which is of course far from true in the present Gregorian Calendar, where a 31-day month can have 27 working days, as compared with a February of 24 working days, a difference of over 11 percent. As a matter of interest, it may be noted that on this

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RIO DE JANEIRO

ASSOCIATED SCREEN NEWS

View showing the beauty of the city's location and the grandeur of the scenery around

Why I Should Like To Visit Rio de Janeiro

By A. JACOB LIVINSON, ARTS '11

WHY should I be eager to visit Rio? What is the secret? I'll confess: It was a lecture. It gave me no rest—no tranquillity, that word picture of a jewelled dream-city from the pages of an enchanted "American Arabian Nights!"

The sheer stateliness and panoramic beauty of the 15-mile long metropolitan and capital city of the Estados Unidos do Brazil—of Brazil, with its 3,300,000 square miles of territory and population of 41,477,827—enthralled me. I was fascinated by the cosmopolitanism of Rio, with its Italians, Portuguese, English, French, Americans, Spaniards, Germans, Austrians, Russians, Japanese, and other nationalities, its corps of police department interpreters, and the remarkable absence of race conflict or prejudice. Dates took on a new significance: 1555, the coming of the French to Rio; 1567, the ousting of the French by the Portuguese; 1825, Brazilian Independence; 1889, the Republic proclaimed; 1931, the sojourn of the Prince of Wales; and 1933, the visit of the Argentinian President, Augustin Justo. And the official holidays—such as Universal Fraternity (January 1), Labour Day (May 1), 1924 Revolution (July 5),

Independence Day (September 7), Republic Day (November 15)—all these added, in my mind, local colour to a captivating description of daily Rioan life. I vowed then that I must see Rio;—and the famous song, *Rolling Down to Rio*, kept ringing in my ears!

Sitting opposite me was my "Pilot". He eyed me, and jokingly said: "You don't need to visit Rio de Janeiro; you've already seen it!"

"True enough," I answered, "but there is nothing like romancing on the spot, walking down the clean, immaculate "avenidas", and beholding the expanding city... and the giant, towering hills in the midst and in the background..." And I also impressed him with data i.e. that Rio is some 15 days (5,023 miles) from Southampton; only 12 days (4,743 miles) out from New York by sea; merely seven days from New York by the Pan-American Trimotor Airliners; or just 3 days from Friedrichshafen by the *Graf Zeppelin*—over 5,000 miles at an average speed of 61 miles an hour.

I need hardly explain who my "Pilot" was. I have travelled over the seven seas, through the stratosphere, over the Eastern and Western

The Calendar of the Future

(Continued from Page 27)

World Calendar, Easter Sunday would fall always on April 8, Victoria Day on a Friday, Dominion Day on Sunday, Armistice Day on Saturday, and Christmas Day on Monday.

Public opinion has been canvassed in a fairly thorough way in Great Britain and in the United States of America, but in Canada, so far as the writer is aware, next to nothing has been done to inform people of the need for reform and of the proposed reforms, or to obtain evidence of public opinion. This ignorance or apathy on the part of our people, and an uninformed autocratic impetuosity on the part of the government are responsible for the laughable or lamentable or humiliating position taken by Canada (according to one's point of view) at the 1931 Conference of 41 nations at Geneva. On this occasion, which was a session of the Fourth General Conference on Communications and Transit called by the League, Calendar Reform was on the agenda and under the chairmanship of the delegate from Great Britain, Sir John Baldwin, the representatives of the 41 nations stated their views on the subject. Stabilization of Easter was definitely agreed upon and incorporated in the draft report. That calendar reform will come, was also generally felt, but that public opinion lags too far behind for an immediate reform was expressed by Great Britain, France, and other leading countries. Rejection of the 13-month plan and interest in the 12-month plan were expressed by Great Britain, Germany, Italy, Japan, Belgium, Greece, Irish Free State, Netherlands, Sweden, and Switzerland. Of these, two gave definite commitments on behalf of their governments for the 12-month equal-quarter calendar, Switzerland and Greece.

And where was Canada? Perhaps my readers had better lay hands on a brandy-flask or a bottle of smelling-salts before proceeding—Canada and Jugo-Slavia made themselves conspicuous by casting definite votes for the 13-month year. The Canadian delegate had been given definite instructions from the Canadian Government to support the 13-month perpetual calendar.

Surely it is high time that Canadians began to look into this matter, and to insist that no Canadian Government commits this country to so important a matter without full knowledge of what it is doing and of what the thoughtful, sane, and mature leaders of other governments are advocating.

If Canadians study this question and come to the conclusion that the 12-month World Calendar

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is the best solution of our present calendar deficiencies, then they should take steps to make a repetition of the 1931 Geneva pantomime impossible.

A suitable date for the change to be made would be 1939, since January 1st, 1939, in the Gregorian Calendar falls on a Sunday and so the old calendar would merge into the new with no dislocation of days whatsoever. It is therefore obvious that the sooner a general interest in the matter is aroused, the better it will be, for public opinion is not often rapidly formed nor are apathy and prejudice easily overcome.

While the above lines have been awaiting publication, announcement has been made that a "Rational Calendar Association of Canada" has been formed, with headquarters in Toronto. This

Association is affiliated with similar organizations in Great Britain, France, the United States, Germany, Irish Free State, Belgium, Switzerland, and Greece—all established for the purpose of arousing interest in and support for the perpetual, 12-month, equal-quarter calendar.

We wish the Canadian Association every success in the accomplishment of its four stated purposes, which are:

(1) To secure withdrawal of Canada's official endorsement, at Geneva in 1931, of a 13-month calendar.

(2) To advocate the world-wide adoption of a rational, perpetual, 12-month equal-quarter calendar.

(3) To inform public opinion on the defects and inefficiencies of the calendar now in use.

(4) To promote the adoption of a stabilized Easter along the lines of the British Parliamentary Act of 1928.

Fournier's Anthology of French-Canadian Poets*

By ROBERT CHOQUETTE

CHERISHED dream of Jules Fournier, one of the finest intellects we have had in Canada, who gathered the material, including verse, biographies, and extracts from critics, this anthology, at the premature death of its author, became the adopted child of Mr. Olivar Asselin, now Editor-in-Chief of *Le Canada*. In 1920, Mr. Asselin published the first edition. A second edition, exactly similar to the first, appeared in the same year. A scintillating preface by Mr. Asselin, and henceforth inseparably associated with this anthology, explained the intentions of the compiler and also anticipated any reproaches that might be levelled against Mr. Fournier's choice of certain moth-eaten poets. Mr. Fournier's main intention was to prove that French-Canadian poetry shows a steady progress. The recently published third edition, which had become imperative due to the great number of writers who had achieved notice in the last thirteen years, amply justifies Jules Fournier's belief.

Twenty-six versifiers of the old generations have been swept away from the present edition. According to one of our critics, all of these singing

forefathers should have been relegated to forgetfulness. For my part, I would say that the selection contains enough of the old ones to afford us the joy of contrast. It must be confessed that in this volume the pages which are of a quality so outstanding as to enjoy immortality are rare indeed. Nevertheless, the anthology establishes its worth by revealing the fact that, from page to page, there is a remarkable ascent towards perfection. The first two editions were interesting mainly from an historical point of view; the third edition holds the breath of life. It is for the most part a book of contemporary poetry. In the last part of the book we feel ourselves caught in the mesh of wills straining to create, of efforts on the edge of full-blown development, of poetical aspiration seeking its consciousness, and all this promise cannot fail to open up avenues of hope.

Right through this anthology run the two great parallel but opposed currents of inspiration which divide French-Canadian poetry: the so-called "nationalistic" one, whose aim is to give us a purely Canadian poetry; the other, an inspiration