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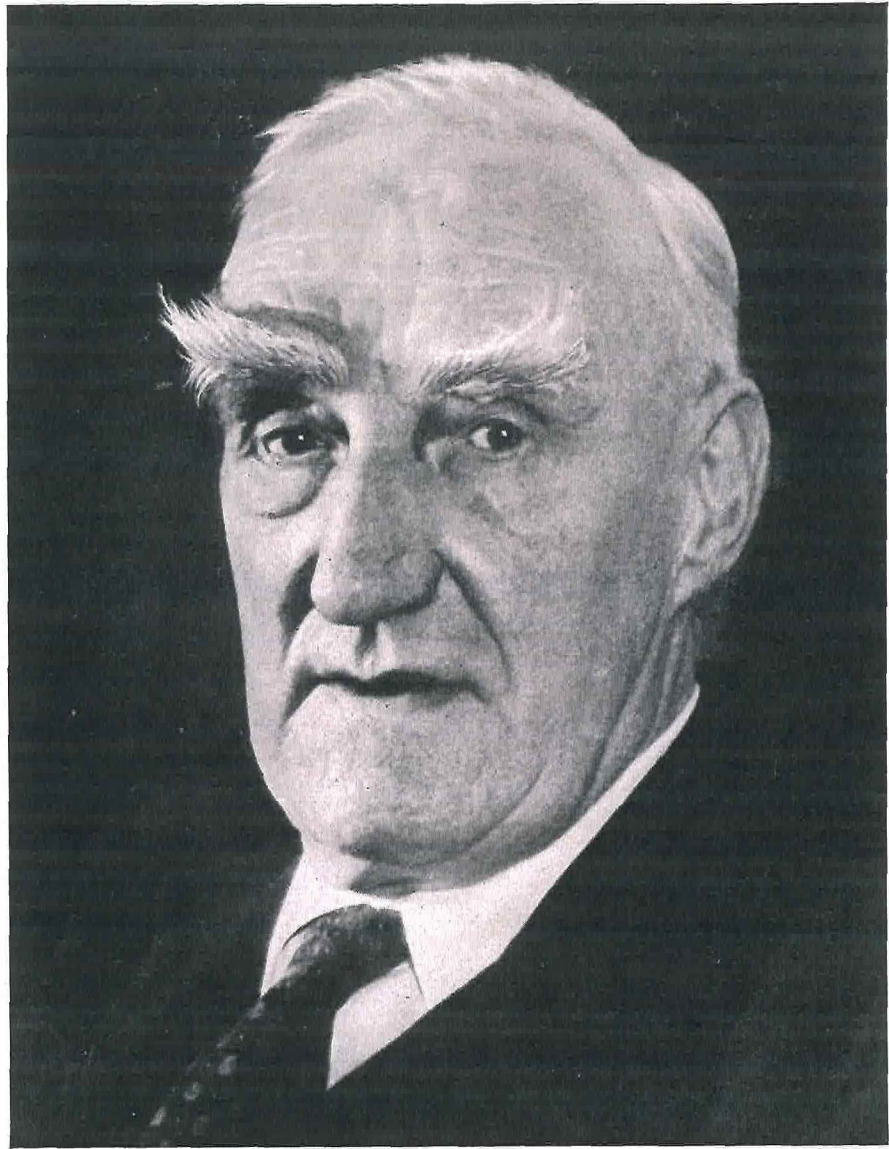
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BARON BOYD ORR OF BRECHIN MEARNES
1880-1971

Elected F.R.S. 1932

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Boyd. Orr

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Elected F.R.S. 1932

JOHN BOYD ORR was born on 23 September 1880 at Kilmaurs, Ayrshire. His father, Robert Clark Orr, was a quarry owner in a small way of business whose interests ranged widely. 'A remarkable man of great ability', he had not only deep religious convictions as an earnest, practising member of a sect of the Free Church of Scotland and in many of his views a Fundamentalist, but was also widely read in political, sociological and metaphysical, in addition to religious issues. John was born into a home where there was no shortage of books and spent his boyhood in an environment of active thinking and expression, particularly when, in the long winter evenings, these issues were discussed at home between his father, his elder brothers and various visiting friends of like mind. As John grew older he took a serious part in these discussions and also in outside activities such as church choir practice, meetings of the local Mutual Improvement Society or the Literary Association, meetings usually followed by debates. Once or twice in the winter months there would be a visit from a travelling concert party, whose concerts he was allowed to attend, but 'promiscuous dancing' was not permitted. (John once stated that he had never heard dance music until he was 27 years of age). But his home atmosphere was happy and the children were allowed much freedom; neither parent inflicted physical punishment. There was family worship each evening. He was the middle child in a family of seven; a sister and two brothers were older and two brothers and a sister younger. Mutual discipline in such a large family could hardly fail to exist.

His grandfather on his father's side had died more than fifty years before he was born, and of him there is little record. His paternal grandmother lived with the family and taught John to read at an early age.

John's mother, Annie Boyd, was the daughter of another quarry master with a rather larger business than Robert Orr. A grandmaster of a Freemasons' Lodge and chairman of the local curling club, he was not unduly bothered with religion, though there was sufficient of the puritan in his character for him to object to card-playing. Annie was a woman of stability and character, and 'a sweet singer of Scots' songs and ballads', who maintained a balanced outlook despite the business ups and downs suffered by her husband. It was after the most serious of these reverses of fortune, when a ship owned by Robert Orr was lost at sea, that the family moved from

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Kilmaurs to West Kilbride, a village among hills, about a mile from the shores of the Firth of Clyde. Even if their means were reduced, from the environmental point of view their new house was a great advance upon the one in Kilmaurs, and gave plenty of room for the growing family. John was five years old at the time. The major part of his up-bringing took place in and around this pleasant village, and it was not till he went to Glasgow as a student and was shocked by the ugliness and poverty of the Glasgow slums that he realized how fortunate he was to have been reared in such delightful surroundings. He attended school at West Kilbride till he was 13. Religious instruction, including the learning by heart of the shorter Scottish Catechism and of passages of the Scriptures, was then an important part of junior education. Each child was provided with a copy of the Catechism which, with Scottish economy, had the multiplication table on the back page! His time at the village school was by no means wasted. There were other important subjects on the school curriculum, which with his eager mind and the stimulus of an intelligent home background, he was able to absorb rapidly. His knowledge of the Bible—and doubtless that of the multiplication table—remained with him all his life.

At the age of 13, John won a bursary, rare in those days even in Scotland, to Kilmarnock Academy which was some 20 miles away from his home. As it happened, his father owned a quarry two miles from the Academy and John was provided with living accommodation near the quarry. The quarrymen were happy to allow him to work their machinery and he spent a good part of the time he should have been at school in their unsophisticated company, picking up much extra-curricular knowledge and 'a wonderful vocabulary of swear words'. He was also passing through the 'Penny Dreadful' stage. As a consequence his stay at the Academy was cut short; he was taken home again and sent once more to the village school where he was soon to accept his first paid appointment—that of pupil teacher at the not too opulent salary of £10 for the first, and £20 for the second year.

The family fortunes, which had been building up, suffered, about this time, a turn for the worse and in addition to his school work, which included not only teaching but also training and home study for the teachers' qualifying examinations, John helped his father for some two hours a day. It was hard work for a youth in the mid 'teens. Fortunately an inspiring headmaster, J. G. Lyon, B.A., came to the school and of the five pupil teachers who studied under Lyon's guidance, three went on to a university and two to technical colleges; all five did well subsequently.

His early school education and his subsequent training up to university entrance level had been largely classical; he had had little or no grounding in mathematics or science. But amongst the many books at home was a *Chambers's Encyclopaedia*, and with this aid John, with his growing interest in the universe of stars and in plant and animal life, was able to supplement the rather narrow instruction given at school. In his first session at Glasgow University he had nevertheless to devote much of his time to Latin, passed

the examination in it—and never looked at a Latin text again. In later life he deplored the amount of time which he and other schoolboys wishing to go to a university had in those days been compelled to spend in studying classics. His lasting dislike for Shakespeare he considered was the result of his having, at school, to analyse and parse *ad nauseam* sentences from the plays. The consequent omission of a wider training did in his view result in a poor foundation for a full intellectual life.

After four years as a pupil teacher John, now nineteen years of age, won a Queen's Scholarship which was tenable at a teachers' training college in Glasgow, and also a bursary which paid for his lodgings. As he had already passed his university entrance examination his fees for a three-year arts course at the University were also defrayed. During this course he had time to continue what he had begun at school and read widely outside the curriculum. Many of his ideas and beliefs, particularly the more dogmatic ones that he had absorbed as boy and youth from his fundamentalist family environment, began to be eroded and finally discarded for a freer outlook. He nevertheless remained sympathetic to the religion of his boyhood. But for his adolescent interest in living creatures and in elementary astronomy he might well have become, as each of his two younger brothers became, an earnest minister of the Scottish Free Church. Indeed his first book, published in 1903, was concerned with religion, supporting his father's participation in the current Presbyterian struggle. To the end of his life he was attracted by the Quakers' quiet philosophy.

There was another extra-academic activity of his undergraduate days. Country bred, and having an enquiring mind, he was interested to explore, mainly during the weekends, the strange interior of the city to which his Queen's scholarship had brought him, an environment different from any he had experienced before. In some of the districts to which his searches led him he encountered the squalid slums and tenements of the submerged, poverty-stricken fraction—at that time a large fraction—of Glasgow's population. The same could be found in many of the large industrial towns in Britain, but was perhaps at its most impressive in Glasgow. Rickets was sadly obvious among the children, malnutrition—possibly associated in some cases with week-end drunkenness—was shown by many of the adults, and there was much evidence of destitution among the aged. These experiences, together with those he underwent later as a young graduate posted to a slum school, were largely responsible for his hatred, which became more intense as he grew older, of poverty, hunger and squalor whatever their origin.

It was a condition of his accepting the award of a Queen's Scholarship that after successfully completing his training course (which in his case entailed taking a degree) he should teach for a certain period. To fulfil this obligation, after he graduated M.A. in 1902, he applied to the Glasgow education authority and was posted, at a salary of under £2 per week, to a school in the slums. In his first class, assembled in an overcrowded room, the children, ill-fed or actually hungry, ill-clad, visibly lousy and physically

wretched, were to be taught subjects in the official school curriculum such as grammar and arithmetic. After a couple of days, realizing that he just could not undertake to teach children in this condition and that there was nothing he could do to relieve their misery, he sent in his resignation. Shortly afterwards he returned home from Glasgow to work in his father's increasing business, remaining so employed for three or four months. He had still, however, to fulfil his teaching obligation, but this time he was appointed to the Kyleshill School in Saltcoats. It was in one of the poorer parts of the town but in a district certainly less squalid than the heart of the Glasgow slums.

Here he remained for about three years and practised somewhat unorthodox teaching methods, not always acceptable to visiting inspectors. There was some disparagement of the school's standards by teachers from the neighbourhood, but the school's morale was boosted when John persuaded four of his brighter boys to compete in an examination for bursaries, six in all, offered to school children from the neighbourhood. He gave these boys, all from poor homes, some extra tuition for three weeks before the examination. Two of his boys headed the examination list, and all four obtained bursaries.

The salary of a trained, graduate teacher was low, and John decided to augment it by instructing a local evening class. The subjects required to be taught were book-keeping and accountancy. First he had to qualify as a teacher in them. After some intensive study he passed the necessary examinations and proceeded to instruct his evening class. The expertise he had acquired by first studying and then teaching these subjects he acknowledged had been of no small value to him in later life. His heart, however, was not in school teaching and, after having accumulated some meagre savings and fulfilled his obligations, he made up his mind to return to the University and study biological science, in which from his boyhood he had always been interested. As a precautionary measure he decided to enter, at the same time, for a degree in medicine. He thus began his second journey in the academic world, to graduate eventually as B.Sc. in 1910 and M.B., Ch.B. in 1912, at the age of 32. He was placed sixth in a year of some 200 students.

At the University, Orr, particularly in relation to his medical studies, found himself in a most stimulating environment. Noel Paton was Regius Professor of Physiology and E. P. Cathcart head of Physiological Chemistry—both men of great character as well as of outstanding scientific ability. Orr greatly benefitted from his many contacts with them. He was greatly impressed by the Professor of Clinical Medicine, Samuel Gemmill, a gifted philosopher. The bonus provided in his clinical classes by Gemmill's deep thinking on social affairs had no small influence on Orr's own subsequent approach to such questions. Others of the medical staff whose teaching made a lasting impression on his maturing mind were Sir Robert Muir, Professor of Pathology and Bacteriology and the eminent surgeon Sir William MacEwan.

Half-way through his medical course, finance became a problem. The small savings that he had accumulated to finance himself at the University began to run out. He had acquired a bursary but even with this addition to his income he became in urgent need of further funds. A responsible man in his late twenties, he was unwilling to ask his family for help, so he did a business deal (showing an ability which became even more evident when he was faced, later on, with the task of raising money for his research institute). With the small capital of only £5 still remaining from his savings and a fairly large overdraft from a friendly bank, he bought a block of tenanted flats on mortgage. These he proceeded to manage himself and made sufficient from the rents to meet the cost of his University course and his living expenses. He even managed to sell the property, after he had graduated in 1912, at a small profit.

When he received his M.D. in 1914, graduating with honours and being awarded the Bellahouston Gold Medal for the most distinguished thesis of the year, he had been associated, as student and graduate, with the University of Glasgow for fifteen years. Later this close association was to be further emphasized when, by vote of the students, he became in 1945 Rector, and by the vote of the graduates, in 1946 Chancellor of his *alma mater*.

To go back to 1912; after Orr had received his M.B., Ch.B. (with the Barbour Scholarship) he had to find, as quickly as possible, funds sufficient to pay off what still remained of his bank overdraft. He decided that, as a ship's surgeon, most of his salary would be available for this repayment. He sought and soon obtained an appointment on an Elder-Dempster boat trading with West Africa. When, after four months service, he resigned from the merchant navy, he had not only enjoyed his post-graduate 'holiday', but was also able to free himself from his debt to the bank.

He was still uncertain as to what he wanted to do in the future. At the invitation of Dr Turner of Saltcoats, his family's doctor, he did a *locum* for him and was offered a partnership. But while he had been sampling what a general practitioner's life was like (and had developed little enthusiasm for it), an offer came from the University of a two-year Carnegie research scholarship, to work in E. P. Cathcart's laboratory. This offer he willingly accepted and thus embarked on what promised to be a career of scientific research. The work he began with Cathcart was mainly concerned with undernutrition (in part of which investigation Orr acted as one of his own research subjects), with protein, creatine and water metabolism, and with the energy expenditure of infantry recruits in training.

Late in 1913, Cathcart, at the invitation of a Joint Committee for research in animal nutrition of the North of Scotland College of Agriculture and the University of Aberdeen, had agreed to go to a new post being established there, with the aid of a grant from the Development Commission, with the object of developing this type of research. Orr had promised to go with him. But before they could make the move, an offer of a chair of physiology in London proved more attractive to Cathcart who, in resigning the Aberdeen

post, strongly advised the Principal of Aberdeen University, who was chairman of the Joint Committee, that they should invite Orr to go to Aberdeen in his stead.

In due course the secretary of the Committee wrote to ask Orr whether he wished to be a candidate for the post. He was not very anxious to go without Cathcart, but the latter persuaded him of the potentialities of the new post and Orr applied for it. He was interviewed by the Aberdeen Committee, understood that the new post involved the running of a small research institute and told the Committee that he had not the necessary experience. Nevertheless, a few days later he received an offer—perhaps the most momentous decision the Joint Committee ever made—of the post at a salary of £360 p.a., with the prospect of continuing, at Aberdeen, the line of research in which he was already engaged. The salary also offered him the prospect of marrying the sweetheart of his youth—Elizabeth Pearson Callum—who had faithfully waited for him (and obtained the degree of M.A. at Edinburgh University in the meanwhile) since their first adolescent but enduring friendship on the Bonny Banks of Clyde. (The marriage took place in 1915, before he went abroad on active service in the army).

After completing some of the research he had been doing in Glasgow, Orr arrived in Aberdeen on 1 April 1914, perhaps an appropriate day on which to find that the Nutrition Research Institute he had been expecting to take charge of did not exist, though a sum of £5000 had been made available to build and equip a wooden laboratory on a site at the College of Agriculture's farm at Craibstone, some five miles from Aberdeen. For laboratory maintenance and payment of the salaries and wages of staff there was also to be an annual grant totalling £1500. Although in those pre-war days, the value of the £ had not begun to depreciate, these were very small sums to work with, and Orr considered them quite inadequate. He did not resign and go back to Glasgow, as he might well have done, but drew up a statement of what he thought would be necessary if an Institute of the requisite size and with the essential equipment was to be built and sufficient staff of the right calibre obtained. In his father's business Orr had had some experience of drawing plans and estimating costs, and the figures with plans that he submitted to his Committee were £50 000 for the building and equipment and £5000 per annum for staff and maintenance. He proposed to the Committee that an appropriate application, with plans and costs, should be sent to the Development Commission, but he was told that this could not be done. In the meanwhile he had with the aid of the Master of Works of the University made plans for the erection of a £5000 building, not of wood but of granite, had drawn up specifications and received tenders, the lowest of which was £5030. This he had accepted, told the contractors to begin at once, and at the next meeting of the Committee the granite walls were about six feet high. Orr had in fact, so designed the building that it could serve as a wing of his proposed £50 000 Institute when the latter had been approved. The Committee was far from pleased, but had to accept the *fait accompli*. Before the next meeting of the Committee war had

broken out and Orr, who had been in the Glasgow University O.T.C. and had been trained for an infantry commission, felt it his duty to join the army. He asked the chairman and secretary of the Committee for leave to do so, which was 'reluctantly given'. Instructions were given to the contractors to complete the walls and roof but go no further for the present.

Orr, determined to join the forces, went to Glasgow to ask his former colleague Cathcart (who commanded the University O.T.C.) to assist him in obtaining a medical commission in an infantry unit overseas. Cathcart told Orr that he would be much more useful, at that time at least, at home and the commission that was offered him soon afterwards was in a special civilian section of the R.A.M.C. which dealt with sanitation. Several divisions mainly of young, non-conscripted recruits were in training at emergency camps in Britain and in some of these the sanitary conditions were extremely poor. Orr's job was hardly a glamorous one, but he was able to push through schemes for hygienic improvements which prevented much sickness in units in his sanitary charge.

After some eighteen months in this capacity Orr managed to get abroad, as he had originally wished, as medical officer to an infantry unit. This turned out to be the 1st Sherwood Foresters—a regular battalion. The first action that he saw was an attack on the Vimy Ridge where the battalion was in reserve but never actually engaged. It was early in July 1916, in the bitter Somme fighting, that his division took part in a major attack. His own unit, like so many other good battalions engaged in this long-continued but ill-prepared attack, suffered severe casualties. Orr, who fortunately came out unharmed, had spent most of his time in the front line of shell holes, patching up the many wounded. The battalion's strength was reduced from some 800 to about 200 in 24 hours, with the loss of nearly all of its officers. The remnants were taken out of the action and sent back to a rear area, where recruits were drafted in, to bring the battalion up to strength and to receive further training. During the training period Orr made an arrangement for the battalion's diet, sufficient in quantity but limited in quality, to be supplemented by vegetables collected from the deserted gardens and fields in the locality, by a fatigue party sent out for this purpose. As a result, from the men in his medical charge he had to send none to hospital, whereas units who relied on their army rations without such supplements (though they may have occasionally received food parcels, mainly of cakes, from home) were much less fortunate. Further, by personally ensuring that his men were fitted with boots a size larger than usual, he prevented them from getting 'trench feet'.

After retraining, the battalion, still with Orr as M.O., was sent first to the Ypres salient and then into the Passchendaele battle, where it successfully reached its particular objective. Orr's courage under fire and devotion to duty were recognized by the award of a Military Cross after the Somme battle and of the Distinguished Service Order after Passchendaele.

Early in 1918 Orr, evidently increasingly worried that though he himself

had not become a casualty, yet under army conditions in France his grip on science and medicine was in serious danger of loosening, persuaded himself that by leaving the army and joining the navy there would be more chance of keeping in better touch with nutritional and medical advances. The army was not anxious to let him go but as Orr was still a 'civil surgeon' his transfer was agreed. He was drafted to the naval hospital at Chatham and spent a very busy three months there, studying hard whilst he practised medicine in the wards. Then he was posted to H.M.S. *Furious*. He found that his medical duties were light and this enabled him to do a good deal of reading. But he had not been with the ship very long before he was officially recalled to work on the food requirements of the *army*, (on which he had made some first-hand observations in the field). He was not transferred but only posted to the army; as a consequence his duties allowed him the rare privilege of appearing either in naval or in military uniform as occasion demanded!

The armistice of 11 November 1918 was declared a few months later. Orr, very anxious to take up again his interrupted work at Aberdeen, sent in his resignation from the forces, and after refusing the offer of a lucrative post in the City of London, returned to the northern city early in 1919. During his absence the walls and roof of the granite building, begun before he had left to join the R.A.M.C., had been completed, and were ready for benches and equipment. But there had been no acceptance of his idea of a larger 'Institute for Nutritional Research'. Even what was to be done with the small grant made in 1914 for staff and maintenance had to be approved by the Professor of Agriculture in Cambridge. Orr promptly journeyed to Cambridge to discuss the whole £50 000 project with Professor T. B. Wood who examined the detailed plans, liked them and took Orr and the plans to the Development Commissioners. But even Orr's steadily developing persuasive powers could not produce a greater result from the Commissioners than a modicum of interest in his scheme and the not very inspiring statement that for such a large capital expenditure, not envisaged in the original grant of 1914, specific Treasury sanction, then, as always, difficult to obtain, was needed. Orr's trip to the South, though it had ended, for the time being, in a mild rebuff from the Commissioners, had earned him the valuable support of T. B. Wood, the effect of which was discernible in later years.

On his return to Aberdeen Orr proceeded to appoint staff for his small, new laboratory. He was fortunate in the first three people he recruited. One of these, Alfred Husband, was a technical assistant with an excellent training, another was James Ironside, a lab. boy who had worked for Orr in the basement of Marischal College in 1914. These were joined soon after by Arthur Crichton, a graduate in both arts and science who had seen much active service in France and who 'despite financial attractions offered in other jobs, devoted the best years of his life to the building up of the experimental farm'.

During the few weeks following his return, Orr with his small staff and using their own hands, fitted the new laboratory with benches, with other laboratory equipment and enough apparatus to make a beginning; in their

lunch hour they constructed an access road to the building from a near-by farm-road. By midsummer 1919 all was complete. The graduate contingent at the laboratory (which was now labelled with a cardboard sign over the door 'The Institute for Research in Animal Nutrition') was soon increased by 50% by the arrival of William Taylor, a medical graduate from Glasgow, who wished to engage in research for his M.D.. Later, Walter Elliott, M.P. for Lanarkshire, also a medical graduate with a science degree and an undergraduate friend of Orr's, agreed to join in the work of the new Institute when Parliament was in recess.

As a student, Elliot had become interested in nutritional science and he pursued this interest at the developing institute for some years—in fact until he became, in 1926, an Under-Secretary of State for Scotland—working both on the relation of the inorganic constituents of the diet to nutritional disorders in pigs and also on the mineral content of pastures and pasture grasses in relation to the health of herbivores. These two topics were of particular importance both to Orr and to Arthur Crichton's brother, John Crichton, whose experienced assistance eventually enabled Elliot to proceed to his D.Sc. degree. The story is told that Elliot in his early days at the Institute did his work on rickets with young pigs which he personally looked after and fed, and whose excreta he collected and analysed (if, for a rising politician, rather reluctantly) entirely by himself.

Orr and Elliot remained close friends till the latter's death in 1958. It is probable that this close association with Elliot, which was of the greatest value for the Institute's progress, also developed in Orr a certain flavour of the political which grew stronger as he became older.

His visit in 1919 to the Development Commissioners was not entirely fruitless, since late in that year his grant for annual expenditure was raised to £4000. But there was no statement regarding his application for a capital grant of £50 000. It was, however, capital that Orr needed and was determined to obtain, if not from Exchequer sources, then in some other way. In 1920, R. H. A. Plimmer, (one of the two founders of the Biochemical Society) was appointed head of a small biochemical section at Marischal College. A friend and former schoolmate of Plimmer's, John Quiller Rowett, who had made a substantial fortune during the war, happened to be in Aberdeen on business and met Plimmer and Orr at lunch. It appears that Rowett had some qualms of conscience about his war-time profits and wished to make use of a part of them for a project which would benefit his country. Orr, persuasive and with a good case, described to him the nationally important functions that an enlarged research institute on lines that he had already planned would serve. Rowett decided that this was just the kind of project he would like to support with funds, and promised to do so.

It was only a short time after this encounter and promise that official approval for his £50 000 plan reached Orr. There was nevertheless the important stipulation that half of this sum must be raised from other than State sources. Orr immediately got in touch with Rowett (then in London)

who followed up his general promise by specifically agreeing to provide £10 000 for the first year and the same sum for a second year. With these funds behind him, Orr took the opportunity of buying some additional acreage urgently needed for his experiments with farm animals. A farm of 100 acres at Bucksburn was purchased for £2000. Rowett, prompted by Orr, undertook to provide the whole of this purchase money also, provided the Treasury would agree that, should work to be done by the Institute on animal nutrition have a bearing on human nutrition, the Institute would be allowed to follow up such work. Since this proposal involved no additional expense to the Exchequer, the Treasury consented.

Now that the essential funds were in sight, Orr lost no time in going forward with the already-planned buildings and by September 1922 they were nearly completed. Some of the rooms were just beginning to be used when the Chairman of the Joint Committee calmly told Orr that he had arranged for Queen Mary to come over from Balmoral forthwith to open what was to be called 'The Rowett Institute'. This suited Orr as regards publicity, but not as regards timing, since the place was not yet ready for such an important ceremony, nor was an adequate complement of animals available to fill the uncompleted pens. But by a major effort from all concerned, the buildings and animal pens were made presentable, though according to local legend the Queen said that the sheep looked tired! They were; they had been travelling all night to provide enough animals for the opening.

In spite of the funds he had obtained, Orr's building and equipment costs considerably exceeded estimates and at one time the Institute was overdrawn at its bank to the tune of some £20 000. Much of Orr's drive and energy was spent in chasing grants—as was the mendicant duty of other directors of agricultural research institutes at this period. With aid from individual Scottish farmers and landowners and from the Carnegie and the Pilgrim Trusts, Orr succeeded in paying off the overdraft within two years. All this took up much of his time and his own output of research suffered. He said later in his life, 'I still look with bitter resentment at having to spend half my time in the humiliating job of hunting for money for the Institute'.

There was a happier side; as the young Institute and its work became better known, Scottish farmers and others from Aberdeen and district interested in animal nutrition began to support it in a remarkable way. Thus in 1923 Dr Walter Reid, principal of a firm of accountants, asked Orr what he would do if a sum of £5000 was put at his disposal for Institute use. Orr had no hesitation in saying that an urgent need was a good library of books and journals dealing with nutritional science, the lack of which had, up to then, been a handicap to the Institute's research staff. Reid's offer was no idle one, and with this sum, to which was soon added a grant from the Carnegie Trust, together with funds Orr was able to secure from elsewhere, the 'Reid Library' was equipped and staffed and later a building to house it was erected alongside the Institute.

In the course of a few years the Library accumulated a substantial collection of abstracts of papers on nutrition which had been published in a world-wide variety of scientific journals. After an Imperial Agricultural Conference in London in 1931 which Orr had attended, he promised, on the basis of this continuing collection, to establish an official Bureau of Animal Nutrition under what was, at that time, the Imperial (now Commonwealth) Agricultural Bureaux scheme. With a further £5000 from Walter Reid, the cooperation of Sir David Chadwick (Secretary of the I.A.B.) and of the Medical Research Council, Orr and the Reid Library accepted the task of establishing and accommodating the 'Imperial Bureau of Animal Nutrition.' From this Bureau, late in 1931, was published the first number of *Nutrition Abstracts and Reviews*. The participation of the M.R.C., both in the abstracting service and on the governing committee of this journal, ensured that it covered human as well as non-human nutrition. After a short period, Dr Isabella Leitch, a member of the Institute's staff with an excellent research background and a knowledge of several languages, took over from Orr the editorship of the journal and later, the whole work of the Bureau, Orr remaining as consultant director. Valuable help was obtained from U.S.A. when Dr Paul Howe agreed to act as one of a small group of consultants from overseas.

To return to the affairs of the Institute proper, it was soon realized that the scanty acreage available for experiments on the nutrition of farm animals—the principal work of the Institute—was becoming a seriously limiting factor. Orr got in touch with a well-to-do banker, John Duthie Webster, the nephew of a well-known breeder of Shorthorn cattle. After certain mild persuasion Webster gave an initial sum of £10 000 to buy some 500 acres close to the Institute buildings and to erect suitable animal accommodation. The farm was to be named the Duthie Experimental Farm, in honour of his uncle. Later, the same donor contributed further funds towards the equipment of the experimental farm which, under the management of Arthur Crichton, who was both a skilled farmer and a scientist, assisted by his brother John with a similar rare combination of abilities, began to make profits. Orr managed to prevent these profits from falling into the maw of the Treasury and ploughed them back into the building, on the Institute estate, of houses urgently needed for farm and other staff. A small Committee of five prominent farmers in the district aided and abetted the Crichtons and Orr in combining the making of profits on the Duthie farm with useful experimental work. One such paying experiment was to find out which, of two good but dissimilar systems of animal management gave, over a sufficiently long period, the higher returns. Both were quite profitable, one rather more so than the other!

By 1929 the acreage of the farm was approaching 1000, of which about 600 acres was arable and 400 was hill pasture. Its animal population at that time consisted of dairy and beef cattle, sheep, pigs and poultry, all under more or less intensive experiment. With the growing reputation, both at home and overseas, of the Rowett Institute as a research centre for animal

nutrition, a reputation vigorously encouraged by Orr's many publications summarizing the work in progress there, the problem became an increasing one of finding both catering and living accommodation, within a reasonable distance of the Institute, for post-graduate students from the Dominions, from other overseas countries and from distant parts of the United Kingdom itself. Some of these students were candidates for a higher degree of Aberdeen University, usually entailing a stay of two or three years. A few senior scientists whose stay was perhaps only a few days or weeks, also found it difficult to find accommodation closer to the Institute than Aberdeen itself—some four to five miles away. Associated with this increasing problem was that of providing an adequate meeting place outside, but not too far away from, the actual laboratories, where those engaged in the different activities of the Institute could, to mutual advantage, exchange ideas and discuss findings.

Orr had, during the mid-twenties, been considering this problem with his Governing Body and his staff colleagues and had, with his usual foresight, drawn up building plans in readiness for quick implementation as soon as the money—which was estimated at about £20 000—could be conjured up. This process was begun with the help of Walter Elliot (by now Under-Secretary of State for Scotland) who invited Orr to lunch in London with Lord Strathcona, a man with great interest in Dominion relationships and also blessed with considerable means. As a result Strathcona offered £5000, later increased to £8000 and on this basis the building was begun in October 1929. With further substantial grants from the Carnegie and Pilgrim Trusts and the University of Aberdeen, together with many smaller donations and even contributions in kind (Walter Elliot, for example, provided carpets for the public rooms) the building, ready for occupation in 1932, was eventually paid for. Orr was even able to persuade Walter Reid, who had made the large initial contribution towards the cost of the library, to provide a further sum to endow an annual Founders' Day dinner to which would be invited a number of distinguished friends and potential friends of the Institute together with senior scientists and former members of the Institute staff, and at which the principal guest would propose a toast to the four 'Founders' (Rowett, Duthie-Webster, Reid and Strathcona).

In the same year, 1932, Orr was elected into the Fellowship of the Royal Society. His sponsors were F. G. Hopkins and J. J. R. Macleod; amongst his official supporters were E. P. Cathcart, W. B. Hardy and T. B. Wood. It is convenient to review here his research findings up to this year, when the pressure of increasing administrative work at home and advisory work both at home and abroad had already made very large inroads into the time he had available for work in the laboratory or the experimental farm. His 500-mile journeys to London were becoming more frequent. Once or even twice a week he would travel up by night sleeper, do a full day's work in London and return to Aberdeen that evening, again by night sleeper. Though he drove himself hard, his own output of original research findings inevitably fell off in the late 20s and early 30s.

His first serious introduction to scientific research had been in Glasgow in 1912, when he began working in Cathcart's physiological chemistry laboratory on protein metabolism, publishing his first paper, jointly with Cathcart, in 1914. It was also in Cathcart's laboratory that he became interested in the effect of water intake on nitrogenous metabolism (in man). With four healthy subjects on four diets containing no creatine but widely differing amounts of protein (27g to 319g) he found that on a high water intake the urinary excretion of nitrogen was increased, most markedly on the low protein diet, (which also caused a fairly rapid decrease in weight of the subject concerned). There was a marked increase in the excretion of urinary ammonia but no excretion of creatine were observed, even on the highest level (9.6 litres per day!) of water intake. There was also a diminution in the faecal nitrogen. In five subjects, two with higher-than-normal blood pressure, water intake of three litres extra per day was followed by a slight fall in the pressure. Orr followed up this finding by a further investigation on individuals, some with normal blood pressures, some with higher than normal and some, pathological cases with still higher blood pressures. He interpreted his findings by concluding that both in apparently normal and in pathological subjects with high arterial tension, the copious ingestion of water is followed by a decrease in blood pressure due to the elimination of pressor substances that cause arterial constriction, (and possibly by a reduction in the rate of formation of these substances in the large intestine).

His D.Sc. thesis (University of Glasgow, 1920) was on the effects of increased water ingestion in man, with special reference to the circulatory system.

Orr had also worked with Cathcart in Glasgow on the energy expenditure of the infantry recruit in training. The findings were published by H.M. Stationery Office in 1929. During this investigation it appeared that, per unit of work, the amount of energy expended, as determined by indirect calorimetry, was influenced by the nature of the preceding meal, i.e. whether it was mainly protein, mainly carbohydrate or mainly fat. The first research that Orr carried out in Aberdeen (with J. P. Kinlock) confirmed these findings. The authors pointed out certain sources of error in determining the respiratory quotient and discussed the significance of that quotient. This work, done in 1920-21 was continued in the following year by Orr and the physiologist H. E. Magee who had recently joined the Institute staff. The subjects now used were ruminants; such animals excrete, in their expired air, along with CO₂, methane (resulting from bacterial fermentation in the rumen). This adds a sizeable complication to this type of metabolic research in the ruminant. Details of their methods were described in their first paper, which was followed by five further communications by Magee (or Magee and Orr) on the influence of external temperature, of pregnancy and of work on the energy exchange in the goat, and also on the metabolic changes in this animal (changes which Orr had examined earlier in human subjects) after the ingestion of food.

In the immediate post-war period, the main source of interest amongst those engaged in nutritional research was the vitamins and some of the earlier discoveries such as those of F. G. Hopkins, on which work had been partially halted by the war, began to be extended. Orr soon found himself involved. For a short period he seemed somewhat critical of their existence, apparently believing that, from the practical point of view, deficiencies in the amount or the balance of the inorganic constituents of the diet of farm stock were sufficient to explain many of the results that had, in his opinion too hastily, been attributed to the absence or shortage of what were, at that time, chemically unidentified entities. His publication of some of these views aroused considerable criticism from Walter Fletcher, then Secretary to the M.R.C.. Eventually Hopkins himself was asked to go to the Rowett and gently point out to Orr the error of his ways. Hopkins, quite firm about the existence of the 'accessory food factors' and of their major importance for animals on a limited diet, came to agreement with Orr that the incorporation of balanced supplements of mineral elements in the feed of farm stock was no less important. Shortly after this visit Orr saw Fletcher in London, and the small hatchet was buried. The Nutrition Committee of the M.R.C. was reconstituted and Orr became a member of it.

From 1920 onward, the role of the mineral constituents of the diet of pigs, dairy cattle and poultry continued to play a large part in Orr's thinking and in the research being undertaken at the young Institute. Publication by him of original work in this field, usually in association with one or more of his colleagues, occurred at fairly regular intervals. There was also a steady output from the Institute of papers, in which his name did not appear on the title page, dealing with vitamins.

The impact on farming practice of the new scientifically-founded knowledge of both minerals and vitamins was explained by Orr in well-written contributions to various, and particularly to Scottish, farming journals. This didactic side of his activities began to take up much of his time. It was highly appreciated and put into practice by many of the intelligent farmers both in the East of Scotland and elsewhere, to the benefit of their farm stock and their pocket. Orr was elected in 1925 President of Section M (agriculture) of the British Association for the Advancement of Science, and took the opportunity, in his presidential address, of recalling some of the earlier history of mineral deficiency in farm animals and of discussing more recent findings in this field. He gave a short summary of the experimental work then in progress at the Rowett on iodine deficiency and on the effect of ultra-violet radiation of the animal on the absorption of minerals from its intestine.

The importance of the mineral needs of grazing stock, particularly of dairy cows, led Orr, in collaboration with Elliot and T. B. Wood, to look into the very variable mineral content of different pastures. Their findings and those of other relevant work in this field appeared in one of the *Miscellaneous Publications* of the Ministry of Agriculture (No. 60, 1928) and also in a more

extensive book published by Orr in 1929. The Empire Marketing Board was particularly interested in these publications, which dealt with conditions on farms in the United Kingdom, in the Empire, and also in other countries abroad. The Board regarded the annual crop of grass as 'one of the main sources of the wealth of the Empire'. The steady depletion of fertility which would follow unless minerals were put back into the soil was emphasized together with the more positive aspect, the latter when Orr, as far back as 1928 ventured to prophesy that 'the total production of the grazing lands of the world can be doubled'—an understatement in 1928 as it is today—if, as he made clear, the nutrient mineral constituents of the soil were added to it in balanced and sufficient quantity and other existing knowledge applied.

Much of the Rowett research on mineral deficiencies in pastures and in feedingstuffs, conducted in the 1920s under Orr's guidance, was admittedly largely confirmatory of previous and somewhat scattered findings made elsewhere, but until Orr brought, or almost thrust, this information to the fore in his lectures, broadcasts and writings, it had received far less than its due attention amongst animal husbandmen at home or abroad. One of the events that had much influenced him was a visit that he and his wife had made to Africa in 1925. There he exchanged information with Arnold Theiler and Harry Green who, at Onderstepoort in South Africa, were working on cattle diseases caused by lack of calcium and phosphate in the feed and resulting in bone deformities, 'lamsiekte,' and much economic loss. From South Africa they went on to Southern Rhodesia and to Kenya, both in difficulties with cattle nutrition. Orr's survey, assisted by Dr Gilks the Chief Medical Officer for Kenya, of conditions in the latter country, (which, like Rhodesia and South Africa was then under British administration) led him to examine the effects of diet not only on cattle but also on some of the human fauna, particularly two Kenya tribes, the Masai and the Kikuyu, living under similar environmental conditions but with very different diets and habits. The tough Masai fed on meat, milk and bovine blood, with a few vegetables, whilst the physically inferior Kikuyu had a diet which was mainly maize. In the neighbourhood of Nairobi Orr found that a cattle disease known as 'Nakuruitis' arose from a condition similar to that causing the South African cattle disease, namely mineral deficiency.

On his return home Orr reported to Walter Elliot that Kenya provided a fruitful field for nutritional research. As a result, a meeting of scientists from the M.R.C., the A.R.C. and the Royal Society was convened by the Lord President of the Council (then A. J. Balfour) and it was agreed that a team of research workers should be sent out. Orr was to make the arrangements and the Colonial Office agreed to provide the funds. In the event, two small teams were sent, a medical group under John Henderson and an agricultural one under Hector Gunn. Both teams had already made good progress when disaster struck them—Henderson died of cancer and Gunn was killed in a motor accident. The loss of two outstanding young colleagues was a severe blow to Orr and he decided to stop the investigations. He did, however,

rescue some of the findings and one member of the agricultural team stayed on in Kenya to demonstrate the excellent results that could be obtained with native dairy cattle even under tropical conditions, if they were adequately fed and managed.

The Empire Marketing Board had, in 1926, established a Research Grants Committee with £250 000 at its disposal. One of its objectives was to promote, in countries abroad which were (at that time) under British administration, the use of modern (and sometimes not so modern) findings and methods for the improvement of agriculture and animal husbandry. The Committee (which included both Walter Elliot and F. L. MacDougall) invited Orr, with his recent, very relevant experience of animal nutrition problems both at home and in Africa, to spread the gospel in certain other overseas countries. Palestine—in which a gospel on a different plane had once had its origin—was early on the list and had asked the Committee for help. A joint visit was made by Sir John Russell, to advise on arable farming, and Orr who was to look at animal problems. Palestine appears to have benefitted greatly from this joint visit, which was followed by another from John Crichton of the Rowett staff, who gave very practical help on the rearing of calves and on dairy husbandry. Orr visited Israel again on several occasions and was delighted with the success of the efforts of the Israeli farmers and horticulturists to increase indigenous food supplies.

With grants either from the Committee or from other sources Orr, in the next few years, was able to visit numerous other countries 'developed' and 'underdeveloped' both in the British Empire and outside it, to observe and advise. The experience he acquired during these visits could hardly do other than greatly influence his thinking and his actions: thus what he saw in Egypt and India intensified the strong feelings he had first experienced in his student days, when in the slums of Glasgow he had seen the extreme poverty with its attendant malnutrition and ill-health amongst the human population. For a man of Orr's outlook his inevitable conclusion, which manifested itself both in his writings from the 1930s onward and in some changes in the direction of Rowett research policy, was that it was no less important to investigate and control the causes of this major and widespread social disease than it was to pursue and apply the Institute's work on animal nutrition. As evidence of this change in direction, Orr managed in 1927 to obtain a sum of £5000 from the E.M.B. Research Grants Committee to undertake an investigation, directed from the Rowett Institute, of the quantitative value of cow's milk in *human* nutrition.

The main problem of the British dairy industry since the early 1920s had been the disposal of surplus milk. Though there was amongst the British public some vague knowledge, left over from the war, of the especial value of cow's milk for the growing child, its use for colouring tea or coffee and, in small amounts, in domestic cookery, was far better known by the majority of the population. As a consequence of this, consumption of liquid milk was depressed, a substantial part of the total milk produced was sold at a low

price to be made into cheese or butter and millions of gallons of separated milk and whey, containing nutrients of high value for human consumption and for children especially, were disposed of by pouring into abandoned mines or into local streams or sewers with results that were easy to predict. Like other nutritionists, Orr was scandalized by this sheer waste of half the human value of the original milk. He proposed and carried out an 'experiment' on the value of milk for a large number of growing school children (actually more of a demonstration than a search for new knowledge) in the well-founded expectation that the nutrition of the children would be notably improved by the addition of milk—or even of separated (skim) milk—to their diet and that these findings, adequately broadcast, would encourage the sale of liquid milk. The participants were children from different large cities in Scotland and from Belfast. At each school the children were divided into three equal groups, one receiving $\frac{1}{2}$ pint of milk per day, another group $\frac{1}{2}$ pint of separated (skim) milk. The third, control group was given, as a placebo, biscuits of the same calorie value as the milk. Each child was medically examined, weighed and measured at the beginning and again seven months later. Compared with the control group there was, even in as short a time as seven months, a marked improvement in health and growth rate of the children in both the other groups, most marked in those children whose home diet was poor.

These findings were confirmed in two tests on similar lines, one carried out under the Department of Health for Scotland and the other, by Orr, on mothers and children in Lanarkshire, and were followed up by a dietary survey of families whose children had been in the test. Stimulated by Orr, Walter Elliot managed to get through Parliament a private Bill by which local authorities in Scotland (and later in England) were enabled to provide cheap or free milk for children in the schools under their control.

The surveys were extended to England, where the dietary conditions in some of the poorer areas of several cities were found to be no less wretched than in Scotland. Orr was now convinced that there was urgent need for a national food policy and in the 1930s, by speeches, writings and radio broadcasts he gave wide publicity to this view. In the Chadwick lecture in 1934 he urged 'a comprehensive food and agricultural policy based on human needs which would absorb all home-produced surpluses'. Financial assistance would be needed from the Treasury. A somewhat similar thesis was well publicized in his lecture given in the following year to the British Association at its Norwich meeting. But the Ministry of Health was not impressed.

Orr had suggested to his friend Elliot, who had become Minister of Agriculture, that all the quantitative findings of the recent dietary surveys should be brought together so that an estimate could be made of the total national food requirements if all the population of the country were to receive an adequate diet. The idea was favoured by Elliot and also by Lord Linlithgow, Chairman of the Market Supply Committee, which had been called together to regulate food imports.

During the preparation of the report, in which Orr was ably assisted by David Lubbock and also received help from the Linlithgow staff, the rumour got about that the document would provide evidence that as much as one-third of the population of the U.K. was too poor to buy enough food to maintain health. This, if true, was a finding with serious political implications. It appears that just as the report was ready to be submitted for publication in book form, a Whitehall Minister saw Orr and told him that to publish would be against public policy and the book should be suppressed. Orr would have none of this and sent the manuscript to Macmillans. With the sympathy of Harold Macmillan, then chairman of the Company, the book, under the title *Food, health and income*, duly appeared in March 1936.

While Orr was engaged in these activities at home, the League of Nations was being induced by Stanley Bruce (later Viscount Bruce), who was High Commissioner for Australia in London, and his economic adviser, F. L. MacDougall, who was a friend of Orr's, to consider the wider problem of the world's food supplies and to operate a 'World Food Plan based on human needs'. The League appointed a Technical Commission on Nutrition in 1935. First a Committee of physiologists, on which Orr sat, drew up a statement of the kind of diets needed for health. It provided the first set of international standards of requirements, published as *The physiological bases of nutrition*. A second Committee, 'The Mixed Committee on the problems of nutrition', was also appointed, with Lord Astor as chairman and Lubbock as secretary, to consider the financial and economic aspects of the plan, together with its international implications. This latter Committee published a final report in 1937 entitled *The relation of health, agriculture and economic policy*. In the following year the representatives of 22 nations met to decide how the action proposed was to be carried out. Unfortunately first the shadow and then the substance of Hitler's war prevented any hope of early implementation. But the phrase 'the marriage of health and agriculture' always to be associated with Orr, had been coined, and the idea was reaching both the Press and the politicians.

Orr had repeated, in a national broadcast in 1937, the statement in *Food, health and income* that the food consumed by a very appreciable fraction of the population of the United Kingdom was insufficient for physical fitness and his point was not lost on those in the Government who were facing the possibility of the outbreak of a very serious war, with its inevitable demands on manpower, if Hitler continued his policy of ruthless aggrandizement.

Orr was asked by Maurice Hankey, secretary to the Cabinet, to visit Germany and report on the state of preparedness of food supplies in the event of war. He went in 1938, accompanied by his son Donald and David Lubbock. There had been conflicting reports, especially on the nutritional status of the adolescents and young adults born during or immediately after the 1914-18 war; Orr found that over much of this period the scarce supply of milk had been largely channelled to pregnant and lactating women and to infants. Thus much of the malnutrition which might have been expected had been

avoided. The 'Hitler youth' were well nourished and fit and after the 1939 harvest the national food supply would be at its maximum.

Orr followed his broadcast of 1937 by a series of semi-popular articles and other publications concerned first with national food policy and, after war broke out in August 1939, with war-time food policy. The most important of these was *Feeding the people in war time* by Orr and Lubbock, published by Macmillan in 1940 (incidentally a book of 88 pages well-printed on good paper, with a stiff cover, priced at 1/6, = today's 7.5 new pence. A comparison with the probable price of a book of similar quality today needs no written comment). With the lessons of the 1914-18 war in mind, Orr and Lubbock's main thesis was that victory in a modern 'all-out' war will depend as much on the morale and powers of endurance of the civilian population as on the efficiency of the fighting forces, and that such morale and endurance could not be maintained unless the whole population was receiving a diet good enough to sustain health (in fact an extension to the civilian population of Napoleon's famous aphorism). There had been a great increase in knowledge of nutrition since 1918 and following the publication of *Food, health and income*, Lubbock, under Orr's direction, had also been carrying out, in the U.K., extensive food consumption and nutrition surveys (for which the Carnegie Trust had provided funds). A rapid analysis of these findings in the light of up-to-date nutritional knowledge was applied by Orr and Lubbock to provide the basis for the outlining of a simple, inexpensive diet, qualitatively and quantitatively satisfactory, that could be provided for the whole population under war-time conditions. In that diet the vitamins and minerals would come mainly from home resources, in the shape of milk and vegetables—by subsidy if necessary—together with potatoes and home-grown cereals to meet a fairly large fraction of the calorie needs. From overseas would be derived the rest of the food required, as commodities which would occupy the smallest shipping space in relation to their food value, such as grains (or flour), sugar, fats and cheese. The supply of home-produced foods such as meat or eggs would be limited by the greatly diminished quantity of imported feeding stuffs. Orr and Lubbock also outlined their considered views on rationing and price-fixing, on the actual and the potential food production in the U.K., and on an agricultural policy to utilize that potential.

J. C. Drummond, then Professor of Biochemistry at University College, London, had arrived late in 1939 at the young Ministry of Food to act as Chief Adviser on Food Contamination. This post, which did not take up more than a fraction of his time, enabled him to see from the inside the endeavours of the Ministry to devise a war-time food policy, and as a nutritionist he was not very greatly impressed. He had been thinking along very similar lines to Orr and Lubbock and like them he decided to put in writing his views as to a nutritionally satisfactory war-time dietary. Early in 1940 he submitted to his Ministry a document, very similar in its essential conclusions to those of Orr and Lubbock, on the type of war-time dietary that, with the food resources likely to be available, should meet nutritional needs

for all sections of the population. The Ministry appear to have been delighted to discover that, by good fortune, they had an expert nutritionist on their staff and they appointed Drummond to fill what had been a yawning gap, that for a Scientific Adviser. The post was clearly one with a very wide scope for influencing national food and nutrition policy. It was doubly fortunate for the country at war that Lord Woolton, energetic and forceful, and with a scientific as well as a business background, found himself, on his appointment as Minister of Food, already equipped with a no less energetic Scientific Adviser with whom he could make easy and effective contact. But neither of them had any direct knowledge of food *production*. Woolton called in Orr, who expounded to him the gist of the comprehensive food production and consumption plan as outlined by Lubbock and himself, and urged the setting up of a high-powered, scientifically knowledgeable Policy Committee to assist the Minister and his Scientific Adviser's department in the devising and implementation, on a sound nutritional basis, of a national food plan applicable to all classes of the population and sufficiently flexible to meet fluctuating war-time difficulties. Such a Committee under the chairmanship of the President of the Royal Society was appointed. The Cabinet itself had also a small Food Committee, some of whose meetings Orr attended, which kept in very close touch with both home and overseas supply conditions and with relevant financial measures.

Well before the war, Orr had decided to retire from the Rowett as soon as he reached sixty years of age, to an Angus farm he had already purchased, but the outbreak of war in 1939, about a year short of his intended age of retirement, completely upset this plan. As a result of his visit to Germany in 1938 he had come to the conclusion that war was virtually inevitable and shortly after his return he set aside certain of the longer-range research projects of the Rowett in favour of experimental work on methods of increasing home food production. But much of this latter work turned out to be short-lived, since within a few months of the declaration of war, most of the members of his staff of military age, though in a 'reserved' occupation, had, with Orr's encouragement, joined the armed forces. Nearly all the remaining male staff including Orr and several others with experience of the first World War joined the Aberdeen Home Guard, whilst most of the women on his staff took up some form of community service. As a consequence from 1940 to 1945 the greater part of the research programme of the Rowett remained suspended. Not so were Orr's activities; much of his time, previously devoted to the effective management and financing of an Institute which, in the short space of 20 years, had become a major research centre, was now taken up in frequent and usually uncomfortable journeys to London to attend national Committee meetings and to have personal discussions with those directly concerned with food policy and distribution. Strongly supported by him in such meetings and discussions was the provision of cheap milk and of vitamin-rich dietary supplements for the 'vulnerable' groups of expectant and nursing mothers, infants and young children.

For the general population the use for breadmaking of flour containing 85% instead of 70% of the original wheat grain, thus ensuring a supply of vitamin B₁, a little extra protein and a more efficient use of the supplies of imported wheat that escaped the torpedo, were other changes in the national dietary that received his active support. So effective were these changes and so good, in spite of war-time handicaps, were the distribution arrangements that the national health actually improved during the war period. According to the Lasker Award Committee of the American Public Health Association this remarkable result was due to the scientific and administrative achievements of the Ministries of Food and Health and to the four leaders Lord Woolton, Sir Jack Drummond, Sir Wilson Jameson (Chief Medical Officer of the Ministry of Health) and Sir John Boyd Orr.

Orr, not being a civil servant, was better able to engage in nation-wide advocacy for improved nutrition than were either Drummond or Jameson. He wrote, lectured and broadcast. In a succession of semi-popular articles and books he dealt with the relation between diet and human welfare, the effect of war on the British national diet, priority for the more protective foods, the effects on British agriculture of changes in food policy and other topics in the broad field of national nutrition in war-time. An activity of Orr's during this period was his collaboration with eleven other Heads of Institutes in the founding in 1941 of the (British) Nutrition Society, of which he became the first President. S. K. Kon of the National Institute for Research in Dairying had prepared the ground for this new Society in a succession of 'Informal Meetings of Nutrition Workers' begun early in 1940, but with the additional impetus of Orr and his eleven co-founders, the new Society had, during the war and has had since then, a conspicuous influence on research and practice in the field of nutrition and dietetics both in the United Kingdom and abroad.

Orr also wrote, with an optimism that was not universally shared, about post-war reconstruction. Some of the ideas in his war-time publications were regarded by a number of the more conservative as Utopian and uneconomic and such a phrase as the 'marriage of health and agriculture' was considered a picturesque slogan with no economic future. But Orr's forecasts were usually well-based extrapolations from the ideas that many thinking people of good will, both in Britain and abroad, saw as likely to permeate, after the catharsis of the war, the policies both of individual nations and of a renewed community of nations.

It was with these thoughts in his mind that Orr, in 1942, accepted an urgent request from Dr Frank Boudreau, (previously the director of the Health Section of the League of Nations and by now the director of the Milbank Memorial Fund, an American foundation concerned with research in preventive medicine), to visit the U.S. and take part in renewed discussions on a World Food Plan.

Orr was able to book a passage on a ship which left Liverpool to travel, in convoy, to Norfolk, Virginia. After much zig-zagging to avoid submarine attack, the convoy successfully reached its destination. Orr lost no time in

travelling on to Washington where he talked with Henry Wallace (then Vice-President), Sumner Welles and Dean Acheson, (Under-Secretary of State) and found them generally in favour of a World Food Plan. He addressed a highly influential gathering in Chicago where the economics of the Plan were closely discussed. The interest of business men and financiers was aroused, and Mrs Roosevelt was also taking an active interest in the proposal. She arranged for F. L. MacDougall, who had been posted to the Australian Embassy in Washington and who was familiar with Orr's plan, to meet the President. The rather optimistic Orr, who returned to Prestwick by air early in December 1942, had hoped that Roosevelt himself might before the end of the year publicly suggest that, despite the war, an international conference should take place to look into the question of a world food policy. The suicidal Japanese act of bombing Pearl Harbour, which brought U.S. into the war, prevented an early announcement and it was not till May 1943 that the President was able to invite all the allied nations to send delegates to a conference, to be held at Hot Springs, Virginia, to give effect to the third of Roosevelt's 'Four Freedoms' of the Atlantic Charter of 1941, namely 'Freedom from Want'.

How far Orr's journey to the U.S. and his impressive exposition of his well-considered World Food Plan had provided the additional impetus to those who were close to, and in a position directly to advise, the President, will probably never be exactly known. There had undoubtedly been a growing body of influential opinion in U.S. that the increase in world food production that could be brought about by the widespread use of modern agricultural knowledge and technique would be sufficient to rid the world of hunger, and should be so used. Orr's enthusiastic advocacy may just have turned the scale. But that enthusiasm does not appear to have impressed the British Government who did not subscribe to Orr's economic philosophy and in spite of an indirect request from U.S., were careful not to include him in their delegation to Hot Springs. MacDougall, who *was* present as an Australian representative kept Orr informed as to what was taking place. What did eventually emerge from the Conference was a firm proposal that, in due course, an international Food and Agricultural Agency should be established. Its duties would not be those of a World Food Board with substantial financing and executive powers but would be limited to fact-finding, the promotion of research and the provision of technical information and assistance on food and on agricultural matters to countries who asked for such help. An Interim Commission with Lester Pearson, then Canadian Ambassador in Washington, as chairman, was appointed to draft the constitution and determine in some detail the functions of the proposed organization.

The circumscribed outcome of the Conference, after what they had hoped for, was very disappointing to both Orr and MacDougall. Nevertheless the Hot Springs resolution was a big step towards their ultimate objective. This resolution, with the Interim Commission's draft providing details of a

constitution, were carried into effect in due course by the decision of the representatives of all the nations that had been united in the prosecution of the war, at a large conference held in Quebec in November 1945. Here was established the first official international agency of United Nations—the Food and Agriculture Organization. But, as Hot Springs had originally proposed and as Orr had feared, the new Organization's powers were to be restricted.

Once again the Government had not asked Orr to be one of their representatives, but Philip Noel-Baker, the leader of the official and, apart from Noel-Baker, rather uninspired British delegation, invited him to join it as an unofficial member. As might have been expected, Orr, after two rebuffs from the Government, was disinclined to accept. Eventually, with the idea in his mind that he would at least have the opportunity of renewing acquaintance, which had hardly been possible during the war, with scientific and other friends from several overseas nations he decided to go as a silent and unofficial observer. Towards the end of the conference, Lester Pearson, at the request of the delegates, asked him to address them. In an unprepared speech Orr gave voice to some of his pent-up feelings with regard to the failure of the conference to seize the opportunity to find funds and authority to meet the urgent needs of the hungry post-war peoples. They 'wanted bread but were to be given statistics'. He implored the conference, even at that late hour, to extend the limited executive powers that they had given to the new agency. But though there was much applause there was no material response to his appeal.

There was, however, an unexpected outcome of Orr's powerful and knowledgeable address. The following day MacDougall told him that the Conference Committee, who had been looking for a vigorous Director-General to give an effective start to the new Organization, were likely to ask him to take this post.

Between the Hot Springs Conference in 1942 and that in Quebec in November 1945 a good deal had happened to Orr at home. As has been mentioned, he had been deeply involved in the nutritional and some of the other aspects of national food policy and its implementation, and had had little leisure during his normal 6½-day week; from 1942 to 1945 he had been Professor of Agriculture at the University of Aberdeen; in 1945 he had been elected with a large majority as an independent member of Parliament for the Scottish Universities and the students of his own University of Glasgow had voted him in as Rector—a three-year post. He had resigned at the age limit of 65 from the Directorship of the Rowett Institute, David Cuthbertson having taken over from him in September 1945. Orr had intended, after his strenuous life at the Rowett and his exacting war-time activities, to have some free time both to assume the management of his Angus farm and to fulfil his Parliamentary duties. If he accepted the post with F.A.O. it would clearly mean increasing rather than diminishing his responsibilities, throwing up his Parliamentary career and his hopes for a quieter life, and being compelled to live abroad. On the other hand, as friends at the Conference who

had heard of the likelihood of his being offered this key post reminded him, he would have a real chance, with help that appeared to be forthcoming, to implement the scheme that he had had in mind for years and had advocated, just before the close of the Conference, with so much applause from delegates.

Orr, sorely tempted, fell. When in due course the post was offered to him he accepted, but set a term of two years to his occupancy of it. This period, he thought, would be long enough to get the new organization established with executive powers if governments could be persuaded to agree . . . 'and if I failed, as seemed to me likely, to retire with honour satisfied'.

Immediately after the Conference, Orr left Quebec for Washington, where he interviewed individually the members of the small staff of Pearson's Interim Commission whose official duties had now almost ended. Most of them accepted Orr's offer of a 5-year contract with F.A.O. and he thus provided himself, at once, with a knowledgeable nucleus staff. MacDougall and Dr Louwes (who had been war-time Minister of Food in the Netherlands) were appointed as his advisers and David Lubbock, who had been released from a prisoner-of-war camp in Germany, his personal assistant. Thus equipped, and with the valuable help of the United States Department of Agriculture, Orr arranged to assemble all available information on the world food position. The results of the survey, hastily got together though they were, were alarming and Orr early in 1946 asked all Governments to send representatives to a special meeting on Urgent Food Problems, to be held in Washington in May, to consider appropriate joint action. Alone among these Governments, the U.K. at first refused, but Orr flew to London, saw Clement Attlee, then Prime Minister, and persuaded him to send a delegation.

At the Special Meeting it was decided that, as F.A.O. by its existing constitution had no powers to deal in an effective way with the ominous food situation, an International Emergency Food Council should be set up forthwith, to be paid for by F.A.O. The Council's duties were to promote, as speedily as possible, the international allocation of those major foodstuffs that were in short supply. The survey had shown that, in 1946/47, nine European countries would have barely two-thirds of their normal supply of food (estimated in calories) and that, from grain-exporting countries, only 20 million metric tons were to be expected, instead of the minimum requirement of 30 million tons.

The establishment of the new Council, which began its work in May 1946, gave Orr further encouragement (if he needed such) to attempt again to persuade Governments to change the constitution of F.A.O., and provide the organization with sufficient funds and the authority to engage, through a World Food Board, in a larger and more significant enterprise—in fact to implement the proposal already made both at Hot Springs and at Quebec 'to eliminate hunger and malnutrition from the world', a proposal which has been described as 'one of the most ambitious designs for international action ever put forward'. It was sent to all Governments of F.A.O. nations with an invitation to send delegates to a Conference in Copenhagen in September.

Orr could now support the proposal with new figures, namely, the recent finding of the expert demographers that the net rate of increase of the world's population was now 22 million a year.

Since it represented a peak in Orr's economic and political endeavours it will be appropriate to give here an outline of what he proposed. It was 'that a World Food Board should be appointed by the member Governments of F.A.O. with the following functions:

'(1) to provide on request by any food-deficient country long-term loans to enable it to purchase surplus foods from food-exporting countries and also industrial products needed to modernize its agriculture to increase indigenous food production. The loans were to be given for approved projects and their use supervised by the international authority.

'(2) The loans were to be given on business lines, but free of interest and of repayment of capital until hunger and abysmal poverty had been eliminated, after which payment of interest or repayment of capital would begin.

'(3) The country receiving the loans would be free to use them to purchase the industrial products needed for agriculture from whichever country it could get them cheapest and most suitable to its needs.

'(4) The international authority would consist of business men representing all areas of the world, under the general supervision of United Nations.

'(5) It would have authority to buy and hold stocks in countries with an exportable surplus of storable foods not immediately marketable after a bumper harvest and to release them from the store after a bad world harvest. This would enable the prices of some of the main foodstuffs to be stabilized within reasonable limits.

'It would also have power to promote the increase of agricultural products in order to double world production in twenty years. The resulting increase in the world's wealth beginning with food (and, later, industrial products) would bring about a great expansion in world trade with increasing prosperity for all countries.

'(6) The cooperation of all nations on a world-wide project of developing the vast potential resources of the earth for the benefit of the wealthy as well as the poor nations would make cooperation easier in political spheres and be an important step in the evolution of the United Nations Organization as a World Government without which there is little hope of a permanent world peace'.

The foregoing proposals, given above in Orr's words, clearly entailed not only the provision by Governments of substantial sums of money but also the handing over, to the proposed Board, of international control over what were looked upon by many countries as important national functions and which, to quote a contemporary economist, 'they regarded as vital to the management of their own economies and their policies of full employment.' Orr's bold scheme would, equally clearly, involve major additions to the functions of the young, and not-yet-proven, F.A.O.

In outlining the proposals to the Copenhagen conference, Orr suggested that if they could be given general approval, a commission should be appointed as soon as possible to make a detailed study.

Despite the enthusiasm of some of the food-deficient as well as some of the food-exporting countries the Copenhagen delegates were divided. Several delegates who were economists were not in favour of the scheme, but the American delegation, headed by Norris Dodd (U.S. Under-Secretary for Agriculture) spoke strongly for the acceptance of the general objectives put forward by Orr. The Conference eventually agreed to appoint a 'Preparatory Commission on World Food Proposals' to examine further the scheme for a World Food Board and report their recommendations to the director-general of F.A.O. for distribution and final consideration by member nations at the (third) F.A.O. Conference to be held in Geneva in 1947.

S. M. Bruce was appointed Chairman of the high-powered Commission, with the following remit: 'to consider how to develop and organize production, distribution and utilization of basic foods to provide diets on a health standard for the people of all countries, and to stabilize agricultural prices at levels fair to producers and consumers alike'. This remit could be interpreted as suggesting a possible watering-down of Orr's confident scheme. In the event, any chance of the Commission's recommending whole-hearted support to the scheme which the decision at Copenhagen had adumbrated was prejudiced at their first meeting by the *volte-face* of the American member from the view, stated unequivocally by Norris Dodd in September 1946, that the U.S. was in favour of the scheme. Now, six months later, the U.S. had changed its opinion. What, with some advantage of hindsight, appears to have happened is that the British delegation, reluctant at Copenhagen, and later both the American and the British members of the Preparatory Commission, had come to the conclusion that the proposed World Food Board could not be effective without a World Government, which the recently-established United Nations Organization was not and could not be, without the most drastic changes in opinion of all the major powers which were becoming more nationalistic now the war was over.

Nevertheless, the Commission's eventual conclusions and recommendations were not entirely negative. They were useful in proposing certain limited extensions of F.A.O.'s official functions and in giving approval to some of Orr's suggestions that did not involve F.A.O.'s assuming supra-national powers. But the major proposals clearly outlined in his scheme, despite their having been accepted at Copenhagen, were quietly dropped. The Commission's recommendations were thus far behind what Orr and those nations still favouring a World Food Board, equipped with far-reaching powers of control over world food supplies and movements, had hoped for. The Geneva meeting of F.A.O. in September 1947 approved the Preparatory Commission's recommendations and advised implementation.

Orr was acutely disappointed at what he regarded as the failure of his third attempt to establish a world authority with full competence to ensure

that all people of the world were adequately fed. He was also angry, both with the British delegates who he considered had arranged beforehand to wreck the plan for which he had worked so strenuously, and also with the U.S. group for what he regarded as a betrayal. He had, in the past few years, with unflagging energy, journeyed the world over, explaining to leaders in many countries what needed to be done and how it could and should be done, driving himself to the limit of his physical health. All his efforts seemed to have been of no avail. But in this disappointment, which remained with him for a large part of his life, he was perhaps underestimating what had been accomplished. He had given F.A.O. a tremendous start and as its beneficial work in its vast task of improving world agriculture and nutrition became more widely realized, a limited number of his early proposals that had not been accepted at the Geneva Conference were eventually incorporated into the Organization's programme. Nevertheless, despite a later attempt made by others in 1949, his World Food Plan was never resuscitated, though Orr believed, to the end of his days, that it would eventually have to be taken up again.

After the 1947 débâcle, Orr agreed to remain in office for a few months whilst a successor was being sought, and was very far from idle. He endeavoured with success to strengthen the three F.A.O. regional offices which had been established in Cairo (for the Middle East) Bangkok (for the Far East) and in Washington (for North and South America), each of which was providing the Organization with valuable information about the agricultural and nutritional needs and potentialities of their areas. After a preliminary survey by F.A.O. of the national food plans and special difficulties of countries in the Middle East, a conference was called, early in 1948, in Cairo, Orr making the opening speech. Much enthusiasm was aroused and many offers of cooperation were made. Two specific plans were evolved, one for a thorough attack on rinderpest and another for a more efficient control of locusts.

Also during this interim period Orr was able to arrange with the Italian Government to move F.A.O. headquarters from Washington to more commodious accommodation in Rome, though he had handed over to his successor (Norris Dodd) and had returned to Scotland before the actual move began.

He was glad to be home. He was now 68 years of age and in his last few months with F.A.O. his health had been vaguely troubling him; apart from his eagerness to meet fully the increasing demands of his highly responsible post, his abiding feeling of frustration after the Geneva decision was doubtless a contributing factor. He was told by Russell Wilder of the Mayo Clinic—one nutrition expert to another—that he was suffering from vitamin deficiency and appropriate capsules were prescribed! But with his return to the Angus farm he had bought before the war his health mended rapidly. He had not, however, returned to a leisured existence, though to a less strenuous one than that of his two and a half years with F.A.O. Beside managing his

farm he found much to do at home and, after a short interval accepted further commitments which took him abroad.

Amongst the home duties to which he returned were those of Chancellor of Glasgow University, a post to which the senior members of the University had elected him in 1946. He proved a dignified, assiduous and competent Chancellor (even at 90 he still wore his Chancellor's robes with distinction). Further, his freedom from the exacting demands of F.A.O. gave him more time to write and lecture. This he did on topics linked directly or indirectly with the urgent need to make full use of the powers of science and of international effort for peace and human welfare, and more particularly with his World Food Plan, which, though it had suffered apparent rejection at Geneva in 1947, he had by no means abandoned. Amongst these topics were *Food, the foundation of world unity*, published by the National Peace Council in 1948; 'Soil fertility—the wasting base of human society' the Sanderson-Wells Lecture, 1948; 'Political problems raised by modern science', the Basil Hicks lecture 1950. To these should be added the address he gave on the occasion of the presentation to him of the Nobel Peace Prize in 1949. In these and other publications he argued that peace must be unstable without the urgent and effective implementation of the plan for providing enough food for the hungry and impoverished peoples of the world. Still more broadly, he considered that it was a major challenge to the political, economic and financial systems of the developed world to show themselves flexible enough to carry to the masses of the people the benefits that new knowledge and applied science were producing in the biological field and in industry.

Another of Orr's activities on his return home was, rather surprisingly, a venture into business. When in September 1945 he had finally retired from the directorship of the Rowett Institute, his main source of income had automatically dried up, but on his appointment with F.A.O. in November of the same year he found his income very considerably increased. Further, as a U.N. official he was not expected to pay income tax. This did not appeal to his sense of justice and he returned one-third of his salary to F.A.O. This was a characteristically generous act but he soon realized that the living and other expenses of Lady Orr and himself in Washington together with their out-of-pocket expenses when travelling made astonishing inroads into the remaining two-thirds and it was as a poor man that in 1948 he left F.A.O. His pension as former director of an agricultural research institute was grossly inadequate to his reasonable needs and activities. He came to the conclusion, by no means sorrowfully, that to meet the ordinary costs of living and to provide a sufficient surplus for travelling he would have to go into business. (It will be remembered that he financed his medical course in Glasgow by buying, managing and later selling a block of tenanted flats). But now, apart from his real abilities as a business man, so clearly demonstrated when he was at the Rowett, he had become an outstanding national figure and as such he was soon able to accumulate a sufficient number of industrial director-

ships to provide him with a bigger net income than he had ever had in scientific research. Further, with the aid of a bright chartered accountant—also a Glasgow graduate—he was able to make a substantial capital sum by some canny work on the Stock Exchange. This removed his financial handicaps and he could now, usually accompanied by Lady Orr, continue his visits to countries either inside or outside the ‘iron curtain’ or whether ‘developed’ or ‘undeveloped’ (to use the uninviting adjectives coined by U.N. but for which acceptable substitutes are difficult to find). These visits, apart from their general interest for a pair of confirmed travellers, provided Orr with additional, first-hand information and opportunities further to extend his nutritional and agricultural evangel. He travelled widely in Europe, America and the East, either as a representative of one or other of the world peace or international trade movements (to be mentioned later) or following an invitation from a Government, or on his own initiative. In Europe he visited for longer or shorter periods Austria, Czechoslovakia, Denmark, France, Germany, Italy, Yugoslavia, Norway, Poland, Romania, Russia and Sweden. In 1949 he was asked by the Indian Government to come to India to help with both the general development of agriculture and with the production and distribution of food—a fairly large series of problems to tackle, even for Orr! He had visited that country in 1929 and had found himself ‘aghast at the poverty’ of the people. In 1949 he and Lady Orr stayed for a while with Nehru in the latter’s house in Delhi and later visited a number of villages to get information at ground level. After further consultations with Indian experts and businessmen, he drafted a report proposing a policy with short and long-term aspects; for the present, the urgent need to procure large quantities of nitrogenous fertilizers from abroad; hardly less urgent, the establishment of an extensive agricultural advisory and control service so that modern methods already employed in some of the agricultural colleges in India, could be conveyed to the peasant farmer. For the future he recommended the manufacture in India itself of a very large tonnage of fertilizers. His report, like others from visiting authorities during the post-war period proposing extensive changes in primitive food-production methods, appeared to raise little immediate response.

Three years later, Orr received a somewhat similar invitation to visit Pakistan, to advise on agriculture and food distribution in both halves of that country. After three months in the field he prepared a report in which rather more interest was taken by the Pakistani Government, especially as he was able to obtain some shiploads of nitrogenous fertilizers as a gift from U.S. He went back to Pakistan to assist in their distribution to the farming areas most likely to give a good return. Officers of the Pakistani army, in the absence of any other reliable service, undertook the distribution under Orr’s supervision.

While in Pakistan he was asked to go to Japan to attend a World Peace Conference in Tokyo; he took the opportunity of seeing something of the advanced and productive agriculture so essential to feed the 100 million

population living on a relatively small cultivated area. On his way back he spent a few days in Cyprus and in Sardinia, both of them islands where the elimination of the mosquito had been recently effected but where anxiety was beginning to be felt at the prospect of having, as a consequence, to grow enough human food to meet the needs of a population likely to double within twenty years.

In the same year (1952) he was invited by a group of economists to lead a British delegation, which included M.P.s, economists from four British Universities and some business men, to an economic conference in Moscow. Among the results of this conference was the setting up of a competent body in London to promote development of trade between the U.K. on the one hand and communist countries including Russia and China on the other. Orr agreed to become honorary president of this committee, 'The British Council for the Promotion of International Trade'. Questions were asked in Parliament about this Council and led to a certain smearing of Orr as a fellow-traveller, which he indignantly denied. He nevertheless continued to regard commercial, scientific and other non-political contacts between Britain and communist countries as valuable channels for the promotion of world peace, whatever the opinion of the Foreign Office. Trade with these countries markedly increased following the establishment of this Council.

Orr visited Poland on a number of occasions after the end of the war, at the request of the Polish Government. He was also in Russia several times in the 1950s on various missions; one in 1959 to endeavour to arrange for the translation and exchange of scientific texts between Britain and Russia. The last of the Russian visits was in 1962, to attend the British Industries Fair in Moscow when he, accompanied as usual by Lady Orr, had an unplanned encounter with Krushchev and Mikoyan. From Moscow they went on to Bucharest and then to Prague. In both Romania and Czechoslovakia Orr had business discussions with Ministers on improving trade with Britain—part of his effort to increase international cooperation and understanding.

One of the most remarkable journeys of Orr and his wife was to China in 1956. They went by air, via Moscow and Ulan Bator in Mongolia, having obtained the necessary visas and also an introduction to a senior Chinese, Huan Hsiang, who arranged for their reception in Peking. In their three weeks' stay in China they were able to see a small part of the country and some of the post-war developments. Orr had discussions with Ministers, usually through an interpreter, on the improvements that had been made in agriculture, public health and education and paid a long visit to Peking University. Later he was shown some of the progress of the previous few years in the exploitation of the very large natural resources of China, particularly the big hydro-electric scheme in the Huni River basin. The Orrs returned to England via Shanghai. The whole Chinese visit is described at some length in the book *What's happening in China* by Orr and Townsend, 1959.

Even at the age of 82 Orr had not finished his world travel. After his visit to U.S. in 1962 he went on, with Lady Orr, to Cuba to see the changes that,

under the Castro regime, had taken place since he had been there in 1947. Though in 1962 he was only three days in the island, he was able to visit the University, which was about to be extended to cater for double the existing student numbers, to see also the beginnings of a large agricultural research station some miles from Havana and to call on ministers concerned with the island's development. He noticed that all the university students appeared to be armed, as were the men among the rest of the population. The two travellers returned via Mexico City to New York and thence home after what was to prove their last considerable journey overseas.

From his early days at the Rowett Institute when his main objectives were first to obtain, and second to persuade farmers to use, sound knowledge on the prevention of mineral and vitamin deficiencies in their livestock, to the later days before and during the establishment of F.A.O., when his world wide aim had become the creation of a 'new era free from the intolerable evils of war, poverty and disease' and to the still later days of his 80s when he was alleged to have retired to his Angus farm, Orr's drive and enthusiasm—usually but not invariably under disciplined control—had never flagged.

As a prophet, Orr was not without honour, either in his own country or abroad. The Prime Minister (Clement Attlee) gave him a peerage in 1948; the following year, much to Orr's surprise, he was informed one evening by his banker that he had been awarded the Nobel Peace Prize of £10 000; also in that year he was made, by President Auriol of France, a Commander of the Légion d'Honneur. Half of the Nobel Prize was given by Orr towards the purchase of a building in St James's Street, London, which was to house both the National Peace Council and other organizations concerned with world government and peace. Orr had agreed to become President of the movement for World Federal Government and he presented £2000 of the prize to this organization, which had its headquarters in Paris. At home, members of the three political parties gave him a notable dinner at the House of Commons where speeches relevant to the progress of that movement were made by Herbert Morrison, Clement Davies and Walter Elliot.

Other awards made to Orr included the Royal Institute of Public Health's Harben medal, which is presented every three years to the man considered by the Institute to have done most to promote health in Great Britain, and the American Public Health Association's Lasker Award (already mentioned) of which he was a joint recipient in 1947. Also from U.S. was the award of the Borden Gold Medal and \$1500, the latter sum to enable him to revisit his old friends in that country. Another pleasant, *ad hoc* award was from an organization called the Faber foundation, which subsidized a month's holiday for Lady Orr and himself in the Caribbean. The American Public Health Association and the New York Academy of Sciences each made him an honorary member. He received a gold medal from the National Farmers' Union of U.S.A., and one from the International Federation of Agricultural Producers.

The numerous honorary degrees he received from Universities at home and abroad, in addition to his robes as Chancellor of Glasgow University, decorated a very colourful wardrobe. They were from Aberdeen, St Andrews, Brazil, Delhi, Edinburgh, Glasgow, Groningen, Manchester, Princeton, Santiago, Vollebach, Uppsala. Dublin gave him an honorary F.R.C.S. Rather late in his life his election to a Companionship of Honour appeared in the New Year's Honours List in 1968.

In physique, Orr was a spare, tough figure who remained so to the end of his life. He usually ate abstemiously but was a confirmed pipe smoker. No one who met him could fail to notice and remember his astonishing eyebrows with the penetrating blue eyes beneath them. His working week was usually the Biblical six days but, when pressure demanded, could easily rise to 6½ or 7. A hard worker himself, he also liked to see his staff put in more than the bare minimum of hours and though a humane person and never unfair in his demands on them, he could become angry if he was convinced of any slackness. On the other hand his characteristic ability to arouse the enthusiasm not only of his own staff but also that of most of those who worked with him rendered this latter contingency very unlikely. But in winter, as soon as the ice was holding, his keen interest and skill in curling, developed in his youth, tended to diminish his normal working hours.

He was not athletic, nor was he keen on outdoor sports; he was neither a golfer nor a shot, but at seasons of the year other than winter he was a sturdy hill-walker sometimes alone and sometimes with a companion such as his friend J. F. Tocher (City Analyst of Aberdeen). He was, till well into his 70s, a keen exponent of Scottish dancing, in spite of the restrictive outlook of his parents to that particular form of art. They had not however prevented his joining the Free Church choir at Kilmaurs and on appropriate occasions later in his life he was known to burst into song and encourage others to do so, though the burden of these ditties had rarely a religious flavour. Nevertheless he had not forgotten his early familiarity with the Bible and was not averse to quoting passages from Holy Writ.

As his military record shows, he was physically fearless; at the Rowett his nonchalant approach on one occasion to an angry Ayrshire bull both impressed and worried his more cautious farm staff. His moral courage and tenacity were no less obvious, they characterized his whole career. He would not compromise with any whittling away of the truth as he saw it; any endeavour on the part of what he regarded as a *misinformed or misled Establishment* to interfere with his well-considered plans was strongly resisted; he would never kow-tow to what he looked on as a repressive bureaucracy, and the suggestion that he should do so roused some stinging comments from the normally peaceful Orr.

He was most fortunate in his marriage, which gave him over fifty years of intelligent, affectionate and almost inseparable companionship and three children—a son, Donald Noel, born in 1921 and two daughters, Elizabeth Joan Boyd born in 1916 and Helen Anne Boyd born in 1919. His son was

shot down and killed on active service with Coastal Command in 1942 while his father was returning by air from America after his mission there to prepare the way for what became the Hot Springs Conference.

His elder daughter, Elizabeth Joan, a medical graduate, is married to Lt.-Col. Kenneth Barton, an agriculturist now farming in Angus; the younger daughter, Helen Ann, a sculptor whose works have been exhibited in the Paris Salon and in the Royal and the Royal Scottish Academies, is married to David Lubbock, referred to earlier, also farming in Angus, a Cambridge graduate who was in charge of the dietary surveys made by the Rowett Institute in the 1930s, and was Orr's personal assistant at F.A.O. The three farms—Orr's, Barton's and Lubbock's are close together and, in fact form a large unit near Edzell. Another farm close by is Arnhall, belonging to Sir William Ogg, a friend of the Orrs from the days when Sir William was director of the Macaulay Soils Research Institute in Aberdeen and later became director of Rothamsted Experimental Station.

In his last few years Orr's splendid constitution began to falter, though his head remained clear. At a party held on his 90th birthday he sang, recited and reminisced cheerfully; shortly afterwards he attended, as Chancellor, the graduation ceremony at Glasgow University. His last public appearance was at the opening by the Duke of Edinburgh, on 30 September 1970, of the new laboratories at the Rowett Institute.

He died, apparently of nothing but old age, on 25 June 1971, in his 91st year. His wife, still with a lively interest in the Women's Rural Institutes and other voluntary activities in Bucksburn and Aberdeen, survives him.

All who knew Orr well, and many who were less fortunate, acclaim him as one of the truly outstanding Scotsmen of his century.

To conclude this memoir it is not inappropriate to quote the paragraph which ends the obituary notice of Orr published in the *Times* of 26 June 1971.

'This lean, long-jawed Scot, with eyebrows like eaves above deceptively mild blue eyes, was a spellbinder. He had no tricks of oratory and an uncompromising Scots accent yet he could bring conferences of Government officials to their feet cheering his forthrightness and obvious sincerity. His latter day *persona* was a combination of all his careers. He was by instinct a doctor who wanted to do something for his patient without waiting for the laboratory reports. In research he was a cautious scientist, but in nutrition he insisted that scientific facts should "work for their living". He was a practical farmer, but his acres extended round the whole world. The preacher who rejected the pulpit became the evangelist of peace through plenty'.

Amongst those to whom I am indebted, in writing this memoir, for information or advice are John Crichton, Isabella Leitch, O.B.E., Evelyn M. Wiseman, David Lubbock (Orr's son-in-law), Sir William Ogg, F.R.S.E., K. L. Blaxter, F.R.S.E., F.R.S., R.N.B. Kay, Sir David Cuthbertson,

F.R.S.E. and the Librarian of the Reid Library, J. C. R. Yeats. I also found Lord Boyd Orr's book *As I recall* most helpful.

The photograph was lent by Sir David Cuthbertson.

H. D. KAY

BIBLIOGRAPHY

1905. *Scotch church crisis: the full story of the modern phase of the Presbyterian struggle*, Glasgow: (pr.) John M'Neilage.
1914. (With E. P. CATHCART.) The influence of carbohydrate and fat on protein metabolism. 3. The effect of sodium selenite. *J. Physiol. Lond.* **48**, 113.
1914. (With E. P. CATHCART.) The influence of acetoacetic acid on the estimation of creatinine. *J. Physiol. Lond.* **48**, xxi.
1914. A contribution to the metabolism of creatine. M.D. Thesis, Glasgow, June 1914.
1914. (With D. BURNS.) The influence of excessive water ingestion on the excretion of creatine and creatinine. *Brit. Med. J.* 19 September.
1914. The influence of excessive water ingestion on protein metabolism. *Biochem. J.* **8**, 530.
1918. Creatine excretion in ruminants. *Biochem. J.* **12**, 221.
1919. (With E. P. CATHCART.) *The energy expenditure of infantry recruits in training*. London, H.M.S.O.
1920. Influence of increased water ingestion on blood-pressure. *J. Physiol. Lond.* **54**, xi.
1920. The physiological effects of increased water ingestion with special reference to the circulatory system. D.Sc. Thesis, Glasgow.
1921. (With J. P. KINLOCK.) Note on the influence of diet on the energy expenditure in work. *J. Roy. Army Med. Corps.* **36**, 81.
1921. (With J. P. KINLOCK.) On the estimation of the physiological cost of muscular work: the significance of the respiratory quotient in indirect calorimetry. *Brit. Med. J.* 9 July.
1922. (On the etiology of rickets.) *Lancet*, **ii**, 394.
1922. The vitamin hypothesis and its practical significance in stock-feeding. *Trans. Highland & agric. Soc. Scotland*, **34**, 52.
1922. (With I. INNES.) The effect on arterial hypertension of increased fluid intake. *Brit. J. exptl. Path.* **3**, 61.
1922. (With W. E. ELLIOT and A. CRICHTON.) The importance of the inorganic constituents of the food in nutritional disorders. 1. Rickets in pigs. *Brit. J. exptl. Path.* **3**, 10.
1922. (With A. CRICHTON and J. J. GREEN.) The value of fish meal as a feeding-stuff. *Scottish J. Agric.* **5**, 146.
1922. (With A. D. HUSBAND.) The importance of mineral matter for growing animals. *Scottish J. Agric.* **5**, 244.
1922. (With A. CRICHTON.) The mineral requirements of the pig. *Pig Breeders' Ann.* p. 25.
1923. The Rowett Research Institute. *Scottish J. Agric.* **6**, 16.
1923. (With J. A. CRICHTON.) The food value of dried whey solids. *Scottish J. Agric.* **6**, 63.
1923. The importance of mineral matter in nutrition. *Trans. Highland & agric. Soc. Scotland*, **35**, 1.
1923. (With A. CRICHTON.) Fish meal and tainted bacon. *Scottish J. Agric.* **6**, 279.

1923. Cod liver oil for poultry. *Scottish J. Agric.* **6**, 349.
1923. (With H. E. MAGEE.) The application of the indirect method of calorimetry to ruminants. *J. agric. Sci.* **13**, 447.
1924. The role of vitamins and of minerals in poultry feeding. *National Utility Poultry Society Year Book*, 1924.
1924. (With A. CRICHTON.) The requirements of the pig for 'vitamin A' and 'vitamin C'. *J. Agric. Sci.* **14**, 114.
1924. (With J. M. HENDERSON and H. E. MAGEE.) The effect of irradiation with the carbon arc on pigs on a diet high in phosphorus and low in calcium. *J. Physiol. Lond.* **59**, xxv.
1924. (With OTHERS.) The nutritive requirements of poultry. The effect of adding vitamin-rich substances to normal rations for poultry. 1. The fat-soluble vitamin or vitamin A. *Scottish J. Agric.* **7**, 264.
1924. The importance of mineral elements in the maintenance of health. *Br. Med. J.* **ii**, 504.
1924. The importance of mineral elements in the nutrition of children. *J. State Med.* **32**, No. 9.
1924. The chemical and physiological properties of milk and their bearing on problems of the dairy industry. *Trans. Highland & agric. Soc. Scotland*, **36**, 40.
1924. (With H. E. MAGEE.) Studies in the metabolism of the ruminant by indirect calorimetry. 5. The course of metabolism after food in the goat. *J. agric. Sci.* **14**, 619.
1924. The influence of nutrition on the incidence of disease. *Vet. Rec.* **4**, 943.
1925. (With OTHERS.) The nutritive requirements of poultry. The effect of adding vitamin-rich substances to normal rations. 2. Vitamin B or the water-soluble vitamin of yeast. *Scottish J. Agric.* **8**, 62.
1925. Vitamins in stock feeding. *Agric. Prog.* **2**, 7.
1925. Mineral metabolism and disease. *Practitioner*, January.
1925. (With OTHERS.) The nutritive requirements of poultry. 5th communication. *Scottish J. Agric.* **8**, 263.
1925. (With A. CRICHTON, J. A. CRICHTON and W. MIDDLETON.) Mineral nutrients in the rations of dairy cows. *Scottish J. Agric.* **8**, 312.
1925. The mineral requirements of dairy cows. *The Milk Industry*, August.
1925. (With W. E. ELLIOT and T. B. WOOD.) The mineral content of pastures. *Scottish J. Agric.* **8**, 349.
1925. (With H. E. MAGEE and J. M. HENDERSON.) The effect of ultra-violet light on the mineral metabolism of the lactating animal. Preliminary communication. *Biochem. J.* **19**, 569.
1925. The mineral elements in animal nutrition. *Rep. Brit. Assoc.* p. 204.
1926. Agricultural research in the British Empire. 1. South African Veterinary Research Station, Onderstepoort. *Scottish J. Agric.* **9**, 290.
1926. (With J. S. THOMSON and W. A. WILSON.) Agricultural research in the British Empire. 2. Agricultural research in Canada. *Scottish J. Agric.* **9**, 357.
1926. (With W. E. ELLIOT and T. B. WOOD.) Investigation on the mineral content of pasture grass and its effect on herbivora. *J. agric. Sci.* **16**, 59; 65; 78; 89; 98.
1926. (With J. M. HENDERSON and A. CRICHTON.) The influence on nutrition of sunlight and artificially produced ultra-violet rays. *Trans. Highland & agric. Soc. Scotland*, **38**, 88.
1926. (With I. LEITCH.) Iodine in relation to plant and animal life. *J. R. agric. Soc.* **87**, 43.

1926. (With A. CRICHTON, J. A. CRICHTON, E. HALDANE and W. MIDDLETON.) The effect of pasteurisation on the nutritive value of milk. *Scottish J. Agric.* **9**, 377.
1926. (With OTHERS.) The nutritive requirements of poultry. 7. Note on growth in chickens. *Scottish J. Agric.* **9**, 392.
1927. (With J. S. THOMSON.) Agricultural research in the British Empire. 3. Agricultural research in New Zealand. *Scottish J. Agric.* **10**, 12.
1927. (With J. L. GILKS.) The nutritional condition of the East African native. *Lancet*, **i**, 560.
1927. (With A. CRICHTON.) Review of recent work on the nutrition of the pig. *Trans. Highland & agric. Soc. Scotland*, **39**, 25.
1928. Milk consumption and the growth of school children. *Lancet*, **i**, 202.
1928. (With G. LEIGHTON, L. MACKENZIE and M. L. CLARK.) Milk consumption and the growth of school children. A test in Scottish schools. *Proc. World's Dairy Congr.* p. 3.
1928. (With W. GODDEN and J. M. DUNDAS.) Iodine in drinking waters. *J. Hygiene*, **27**, 197.
1928. (With H. E. MAGEE.) Calcium and phosphorus in the metabolism of the lactating animal and factors that influence their assimilation. *Proc. World's Dairy Congr.* p. 42.
1928. (With F. C. KELLY and G. L. STUART.) The effect of iodine manuring on the iodine content of plants. *J. agric. Sci.* **18**, 159.
1928. The nutritive value of pastures from the point of view of the mineral content. In *Ministry of Agriculture and Fisheries Miscellaneous Publications* No. 60, London; H.M.S.O.
1928. The influence of diet on the physiology of the stomach. In *Gastro-intestinal diseases*. Oxford University Press.
1929. *Minerals in pastures and their relation to animal nutrition*. London: H. K. Lewis & Co.
1929. The composition of pastures. E.M.B. No. 18. H.M.S.O.
1929. (With I. LEITCH.) Iodine in nutrition. *Medical Research Council Special Report Series* No. 123. London: H.M.S.O.
1929. (With A. CRICHTON, E. SHEARER and M. SPEEDY.) Milk substitutes in the rearing of calves. *Scottish J. Agric.* **12**, 168.
1929. The relation of the chemical composition of pasture to its feeding value. *Trans. Highland & agric. Soc. Scotland*, **41**, 99.
1929. The calcium and phosphorus requirements of farm animals and the effects of deficiencies. *Proc. Vet. Congr., Ayr.*
1929. (With A. CRICHTON and W. MIDDLETON.) A note on the toleration of farm animals for high doses of iodine. *Vet. Rec.* **9**, 1055.
1930. *Investigation on mineral deficiencies in pastures of Kenya Colony and effects on grazing animals*. London: H.M.S.O.
1930. (With M. L. CLARK.) A report on seasonal variation in the growth of school-children. *Lancet*, **ii**, 365.
1930. (With M. L. CLARK.) A dietary survey of six hundred and seven families in seven cities and towns in Scotland. *Lancet*, **ii**, 594.
1930. The influence of diet on susceptibility to disease. *Trans. Highland & Agric. Soc. Scotland*, **42**, 28.
1930. (With I. LEITCH.) Iodine in practical agriculture. *Internat. Rev. Agric.; Mon. Bull. agric. Sci. Practice* **21**, No. 6.
1930. The role of vitamins and minerals in stock feeding. *J. Min. Agric.* April and May.
1930. (With G. S. ROBERTSON, J. H. PRENTICE and A. J. MACDONALD.) Nutritive requirements of poultry. 7. Growth in chickens. 3. *Scottish J. Agric.* **13**, 410.

- 1930-31. (With H. R. DAVIDSON.) Observations on the nutrition of breeding pigs. *Pig Breeders' Ann.* p. 53.
1931. Iodine supply and the incidence of endemic goitre. *Medical Research Council Special Report Series* No. 154. London: H.M.S.O.
1931. (With J. L. GILKS.) Studies of nutrition. The physique and health of two African tribes. *Medical Research Council Special Report Series* No. 155. London: H.M.S.O.
1931. (With A. HOLM.) The influence on animal health of minerals in diet. *Economic Advisory Council Committee on the Mineral Content of Natural Pastures, 6th Report.* London: H.M.S.O.
1931. The development of the science of nutrition in relation to disease. *Brit. Med. J.* p. 883.
1931. The national importance of stock farming. *Scottish J. Agric.* **14**, 16.
1931. (With J. J. R. MACLEOD and T. J. MACKIE.) Studies on nutrition in relation to immunity. *Lancet*, **i**, 1177.
1931. Faulty diet as a factor in disease. *Scottish J. Agric.* **14**, 383.
1932. (With A. CRICHTON.) Improvement of permanent pasture. *Scottish J. Agric.* **15**, 66.
1932. (With A. H. H. FRASER.) Restoring the fertility of Scottish sheep grazings. *Trans. Highland & agric. Soc. Scotland*, **44**, 64.
1933. (With L. S. P. DAVIDSON, H. W. FULLERTON, J. W. HOWIE, J. M. CROLL and W. GODDEN.) Observations on nutrition in relation to anaemia. *Brit. Med. J.* **i**, 685.
1934. *The national food supply and its influence on public health.* Chadwick Lecture. London: P. S. King and Sons.
1934. (With M. B. RICHARDS.) Assay of vitamin A. *Nature, Lond.* **133**, 255.
1934. (With M. B. RICHARDS.) Growth and vitamin A deficiency. *Biochemical J.* **28**, 1259.
1934. (With A. H. H. FRASER and D. ROBERTSON.) Parasitic worms and their importance in sheep-farming. *Trans. Highland & agric. Soc. Scotland*, **46**, 113.
1934. (With A. H. H. FRASER and D. ROBERTSON.) The problem of parasitic roundworms in sheep. *Trans. Yorkshire agric. Soc.* No. 91, 35.
1935. The role of inorganic elements in nutritional anaemia. *Proc. R. Soc. Med.* **28**, 469.
1935. The economics of diet. *Rep. Brit. Assoc.* September.
1935. (With W. THOMSON and R. C. GARRY.) A long term experiment with rats on a human dietary. *J. Hygiene*, **35**, 476.
1936. Public health and agriculture. *J. Farmers' Club*, February.
1936. *Food, health and income. A report on a survey of adequacy of diet in relation to income.* London: Macmillan & Co., Ltd.
1936. The trend of changes in the agricultural economic system. *Trans. Highland & agric. Soc. Scotland*, **48**, 122.
1937. Agricultural research as a career. Some coming developments. *J. of Careers*, **16**, 537.
1937. Nutrition in relation to education, agriculture and medicine. *Health and Empire*, **12**, 192.
1937. The science of nutrition and agricultural policy. *National Farmers' Union Year Book*, p. 321.
1937. (With P. J. DOLLAN and OTHERS.) *Eleventh hour questions.* Edinburgh and London: Moray Press.
1937. (With A. V. HILL and OTHERS.) *What science stands for.* London: George Allen and Unwin, Ltd.
1937. Not enough food for fitness. *The Listener*, 26 May.
1937. In *The Scotland of our sons.* (Two chapters by Sir John Orr.) London: A. MacLehose and Co.

1938. (With I. LEITCH.) The determination of the calorie requirements of man. *Nutrition Abstr. & Rev.* **7**, 509.
1938. A review of the development of milk marketing. *Trans. Highland & agric. Soc. Scotland.* **50**, 133.
1939. *Health, agriculture and the standard of living*. London: The Economic Reform Club.
1939. Nutrition problems. Dietary requirements for health. *Canad. Med. Assoc. J.* **41**, 78.
1939. The physiological and economic bases of nutrition. Harben Lectures. *J. R. Inst. Public Health & Hygiene*, **2**, 661; **3**, 9, 37.
1939. Nutrition during war-time. *Nature, Lond.* **144**, 733.
1940. (With D. LUBBOCK.) *Feeding the people in war-time*. London: Macmillan & Co., Ltd.
1940. Food and the ordinary man. *Chamber's Journal*, p. 732.
1940. Food science in the future. Food Group Jubilee Memorial Lecture. *Chemistry & Ind.* **59**, 353.
1940. *Nutrition in war*. Tract Series No. 251. Fabian Society, 11 Dartmouth Street, London.
1940. (With J. C. DRUMMOND, R. McCARRISON, F. KEEBLE, L. H. LAMPITT, V. H. MOTTRAM and J. C. SPENCE.) *The nation's larder and the housewife's part therein: a set of lectures delivered at the Royal Institution of Great Britain*. London: G. Bell & Sons Ltd.
1941. Nutrition and human welfare. *Nutrition Abstr. & Rev.* **11**, 3.
1942. *Fighting for what?* London: Macmillan & Co. Ltd.
1942. Foundations of the New World Order. *Nature, Lond.* **149**, 401.
1942. Speech delivered at a meeting of Government Agencies represented on the Inter-departmental Nutrition Coordinating Committee. Federal Security Agency, Office of Defense Health and Welfare Services, Washington, D.C.
1943. *Food and the people. Target for Tomorrow No. III*. London: Pilot Press, Ltd.
1943. Nutrition and psychology. *J. Education*, **75**, 159.
1943. The role of food in post-war reconstruction. *Internat. Labour Rev.* **47**, No. 3.
1943. Department of Health for Scotland. Infant mortality in Scotland. Report of a sub-committee (Sir John Orr, Chairman) of the Scientific Advisory Committee. Edinburgh: H.M.S.O.
1944. The probable effects on British agriculture of the recommendations of the United Nations Conference on Food and Agriculture. *Trans. Highland & agric. Soc. Scotland*, **56**, 1.
1944. The effect of the war on the British national diet. *Digest of Treatment*, **8**, 280.
1944. (With F. WELLS.) *Housing and health. Design for Britain* (Second series). J. M. Dent & Sons, Ltd.
1944. Influence of science upon politics. In *This changing world* (ed. M. BRAMWELL). London: Routledge.
1945. (With OTHERS.) *Welfare and peace*. Peace Aims Pamphlet No. 34. London: National Peace Council.
1945. The food of the future. In *Post-War Britain* (ed. Sir JAMES MARCHANT). London: Eyre and Spottiswoode.
1946. *Food and Agriculture Organization of the United Nations. Proposals for a World Food Board*. F.A.O., Washington, D.C.
1946. *Food and Agriculture Organization of the United Nations. First annual report of the Director-General to the F.A.O. Conference*. F.A.O., Washington, D.C.
1946. *A charter for health*. By a committee of the British Medical Association under the chairmanship of Sir J. B. Orr. British Medical Association.

1948. *Food—the foundation of world unity. Towards world government.* No. 1. London: National Peace Council.
1948. *Soil fertility—the wasting basis of human society. Sanderson-Wells Lecture.* London: Pilot Press.
1949. The world food situation. *Vet. Rec.* **61**, 491.
1950. *Science, politics and peace. Lecture delivered on the occasion of the award of the Nobel Peace Prize of 1949.* London: National Peace Council.
1950. *Political problems raised by modern science. The Basil Hicks Lecture delivered to the University of Sheffield,* 10 November 1950. Sheffield; J. W. Northend.
1951. *The role of the rebel in society. Maxton Memorial Lecture.* London: James Maxton Memorial Committee.
1952. *Geography of hunger.* By J. DE CASTRO (with a foreword by Lord Boyd Orr). London: Victor Gollancz Ltd.
1953. (With D. LUBBOCK.) *The white man's dilemma: food and the future.* George Allen and Unwin, Ltd., (translated into at least 8 languages). A second edition was brought up to date by Lubbock and published by Allen and Unwin in 1964.
1957. *Feast and famine: the wonderful world of food.* London: Rathbone Books.
1959. (With P. TOWNSEND.) *What's happening in China?* London: Macdonald & Co. Ltd.
1966. *As I recall. The 1880's to the 1960's.* London: MacGibbon & Kee Ltd.
1968. *Feeding the world. Sci. Jl.* **4**, 3.



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