condition to survive the winter or to make early growth in spring, on account of the lack of sufficient reserves in the roots. Nitrogenous manures applied in spring are no substitute for adequate over-wintering root reserves.

Leguminous plants may possibly excrete nitrogen fixed by the aid of their associated nodule bacteria, and may thus act as nitrogen 'foster-mothers'. The dynamics of the plant include several modes of return of absorbed material to the soil. The most obvious in perennial plants is leaf-fall.

A more interesting mode of return of nutrients to the soil is apparently common to annuals and perennials. It is what the Rumanian worker N. T. Deleanu has called *Rückwanderung*. The demonstration of this process is not very simple with modern data, but the work of J. I. Pierre in the 'sixties is of interest¹³. Table 3 shows amounts of some elements present in the whole wheat plant.

TABLE 3
KILOGRAMS OF CONSTITUENTS IN A HECTARE OF WHEAT (WHOLE PLANT INCLUDING ROOTS). (AFTER J. I. PIERRE, 1863.)

	June 13	June 29	July 13	July 30 (harvest)
Total organic matter	5400	6500	6900	6800
N	76	76	68	70
SiO ₂	191	252	214	228
Fe ₂ O ₃	15	30	17	19
CaO	44	45	44	36
K ₂ O	39	55	34	34
P ₂ O ₅	18	19	18	23
„ in ears	2	4	7	17

There is a maximum of richness a month before harvest; the only constituent that goes on increasing is phosphorus in the ear. While possibly some of the potassium is washed out by rain, it seems that part of the early stock of nutrients has been returned to the soil. Plants can absorb ions from true solution, but the soil solution theory is unable to account for *Rückwanderung* or for what has been called contact depletion.

The ideal soil is not composed of discrete mineral grains, but of crumbs or aggregates. These include colloidal matter of two kinds—mineral colloids and organic colloids. The latter may be partly humus, which may be regarded as an *end-product* of the microbial decomposition of organic matter. In a fertile soil the organic matter includes a sticky material less inert than humus, and resulting from the recent decomposition of organic matter¹³. This organic cement sticks the grains together into small crumbs which have the most desirable physical properties. It is not the microbes which are important in soil, but the products of their recent activity are important.

There is reason to believe that the plant and the soil with which it is in contact form a practical continuum. This contention gains weight from the work by H. Jenny and R. Overstreet on ionic exchange.

If plants are grown in mixtures of sand and calcium clay, the roots accumulate calcium ions, whereas the clay particles gain in adsorbed hydrogen ions. Contact exchange is postulated to take place only when the (cation) oscillation spaces of particles overlap: the particles may be both clay, or one may be a root surface, both being negatively charged. Contact intake is difficult to investigate on account of a presumed high gradient of carbon dioxide in the

neighbourhood of a root, but there is very suggestive evidence of contact depletion, so that the theory of contact exchange of ions may be regarded as having made a promising beginning. There is yet no evidence for contact exchange of anions. No contact jumping of cations could be found between roots and positive iron hydroxide sol¹⁴.

The disposition of materials by plants is a highly dynamic and largely cyclic set of processes. There are, of course, wheels-within-wheels: short-period cycles as well as long-period cycles. The broad cyclicity of nutrients is well shown in the tropical rain forests, where most of the nutrient stock remains, and the greater part of the nutrient cycle takes place, *above* the ground. In cool humid climates the cycle is impeded, and valueless plants such as heather constitute the type vegetation. The ideal agricultural soil is one in which the cycle is fairly shared between soil and plant. Artificial modifications in pursuit of the full roundedness of the soil/plant cycle are the purpose of man's operations in cultivation and manuring.

¹ *Ann. Bot.*, **37**, 629 (1923).

² Sci. Sect., Natl. Paint, Varnish and Lacq. Assoc., Circ. No. 446, 607 (1933).

³ *NATURE*, **140**, 317 (1937).

⁴ *J. Roy. Agric. Soc.* (Ser. 3), **1**, 384 (1890).

⁵ *J. Amer. Chem. Soc.*, **62**, 234 (1940); *J. Biol. Chem.*, **139**, 649 (1941).

⁶ Mellor, J. W., "Treatise on Inorganic Chemistry", **5**, 149 (1924); *Chem. and Industry*, **11**, 156 (1933).

⁷ *J. Amer. Chem. Soc.*, **62**, 3443 (1940); *Chronica Botanica*, **6**, 337 (1941).

⁸ *Proc. Roy. Soc. Edin.*, **50**, 130 (1929).

⁹ *Amer. J. Bot.*, **24**, 417 (1937); *Canad. J. Res.*, **15** C, 33 (1937).

¹⁰ *J. Pomol. Hort.*, **17**, 99 (1939).

¹¹ *J. Agric. Sci.*, **24**, 532 (1934).

¹² See *Agric. History*, **10**, 2 (1936); *Chem. and Industry*, **14**, 560 (1936).

¹³ *Soil Sci.*, **49**, 1 (1940); *J. Amer. Soc. Agron.*, **32**, 204 (1940).

¹⁴ *Soil Sci.*, **47**, 257 (1939).

AD ASTRA*

By THE RIGHT HON. LORD BRABAZON, P.C.

I THINK I am speaking the truth when I say that those who were responsible for the birth of flight thought of it as a new force in the world for peace, for prosperity and for true internationalism. Here was to come something which would make the world a happier place by a quick form of transport, that would bring us all closer together. It was for that idea that I saw my friends pour out their meagre fortunes in experiment, and risk their splendid lives in brave endeavour. I contend that the crushed, shapeless or charred embers of so many victims were well sacrificed, if they were to bring about such ideals. But mechanical science outstrips human wisdom, until we find we have created a juggernaut that may indeed destroy us. I want it clearly realized that if to-day flight bears the brand of Cain, it is not on the pioneers that the blame should be laid, but on foolish politicians of many countries.

Holt Thomas must bear an honoured name in trying to use war aircraft for civil purposes, with resultant commercial disaster. The Government stepped in with half-hearted support to an enterprise which meant so much to a far-flung Empire, but so lacking was vision that the only thing ever indulged in was puny assistance to civil aviation and, on the military

* Part of the Wilbur Wright Memorial Lecture for 1942 of the Royal Aeronautical Society, delivered on May 28.

side, the provision of a few squadrons of aircraft, always at least seven years out of date.

The while Governments were striving after war machines it was left to keen competition in civil aviation in the United States to bring about the first real advance in civil flying. The Douglas is so well known as not to warrant description, but it did promise that at long last the civil side of flying was to go along a separate path in development, and would become divorced from military development. It was later found that as a military bomber the commercial machine was superior to all Government-produced machines.

It has been said by many, and there is much truth in it, that it would be better for us to win the War first before we think and plan for post-war situations. This is one of those half-truths that are so very dangerous, leading one really astray.

The Germans are fighting for a post-war position. We are fighting to resist the imposition upon us and others of an intolerable post-war bondage. Surely, therefore, we both have in our minds the whole time a post-war position. If that is so, there is nothing to be ashamed about or to find deplorable in supposing victory, and to allow one's mind to browse over some of the ameliorations that we should like to see introduced into our beloved country.

The early struggles of flight had not got very far when there came the War of 1914-18. Into that effort there was a tremendous concentration on aviation. For the first time all the efforts of engineers and other men of science were concentrated on the subject with, moreover, unlimited money behind it. It was a mushroom growth not entirely on healthy lines. Field of fire, manoeuvrability, lack of blind spots, rate of climb were all points of first importance. Such things as pay load, initial expense, inherent stability, economy of fuel consumption, lack of danger from fire: all those really basic matters that would have come into normal development of a new form of transport were passed by and we were left at the end with certainly a very wonderful advance, but one upon which debate may still rage as to whether the quick growth really helped the science along or retarded it.

I have said that Holt Thomas, trying to use war machines for civil purposes, found that it was an impossibility, so detached from an economic machine had the aeroplane become. Many of us hoped and prayed that a very real divergence would come about between the military type and the civil type. This was not to be, however, anywhere except in the United States, where free competition developed in a country of astronomical distances, which was made for flying development.

All Governments, almost without exception, put their hands upon the aeroplane and said that the State would do this and not allow that. They always saw through a sort of fog also that they must regretfully have at their disposal a nucleus of private firms making aircraft against the necessity of another war.

Civil aviation was born too soon from the bowels of the War of 1914-18 and was mis-shapen from the start, so that it could not, until completely reorganized from a design point of view, *fly by itself*. A vicious circle ensued, therefore, wherein firms wanted to make a civil machine, but as air transport could not pay there were no buyers, and as they had to keep alive they continued making machines that were suitable for war purposes only. Slowly the industry became the tools of the air bureaucracy of their country, who dictated to them what to make. With a lip service

to disarmament, actually to keep alive an industry for war, State subsidies started up and down the world nominally to keep flying services going. Take the case, just as an example, of engine development. In all other forms of transport the C.I. or Diesel engine has displaced the petrol engine, for economy in the case of ships and for the buses of London. Notice it was adopted here not entirely for reasons of safety. But in an aeroplane the safety reason was of paramount importance. The statement that I have had given to me, that fire did not matter as most people were killed before they were burnt, is a travesty of the truth, as an aeroplane is never in more danger than when it is not going very fast and is in contact with the ground. Yet did a C.I. engine emerge? No. For this reason: Governments were not interested in it, as it showed no great advantage for war and therefore the manufacturer had no market in which to sell his product if the State-run air-service was not going to encourage such a thing.

Thus history shows that the birth of flight was of clean parents; but due to the War of 1914-18 it was branded with the mark of Cain and ever since it has been tied to the apron strings of Mars. It is a sorry story, and although here and there I and others can point to some cases of honourable endeavour to get away from the position I have described, I think that most fair-minded people will agree that what I have said is the truth.

Is there to be such lack of imagination, such supineness, shown in the world again? I feel it only right that we should consider this problem while we are under stress and strife, and plan and arrange the future. Otherwise I know that it will pass to a tired and poor post-war world with little energy or imagination, only wanting to be left alone to lick its wounds.

I take it first of all as axiomatic that those nations that have fought together and suffered together, and won together, are going to remain friends and work together. What is curious, however, is that most of these nations are, above all, nations that are concerned with very long distances as the basis of communication. I suggest that the United States, the U.S.S.R. and the British Commonwealth, with the United Nations, should announce that henceforth they jointly and solely take charge of all aircraft and all flying, that the *Usque ad Caelum* (ownership of air above any particular piece of ground) doctrine goes and that in future they give themselves the right to fly whithersoever they like, and that no one anywhere on earth shall fly without their consent. Thus there will be a watching force to see that nowhere in the world shall a nation secretly build up an air force for mischief. This combination will be the start of a Kipling's "A.B.C." It would, of course, delegate to countries their own internal organization for local flying, but always under its broad control. But the great long-distance highways will be in their charge and run by international crews. They will at first operate war machines for intercommunication until better are made by the industry existing, which cannot be dissolved overnight. In return for taking upon itself these great powers, the World Board will guarantee all States against aggression and will constitute to itself the policing of the world. Where we make a difference from the League of Nations idea is that here we will be creating, right at the beginning, a force of transcending power that no one can challenge, instead of a debating chamber that had no force at its command. I do not for one moment lay it down that at the right time our present enemies should not

come into the general scheme. The idea is world co-operation and not penalization. It is high time with the resources at our command that we protected ourselves against a world war every generation. Here in our hands we have the instrument so to do.

A world-wide development of civil flying would have great repercussions on human life and materially improve the standard of living. The exploitation of this great invention to be put to the use of man rather than his destruction is long overdue. The world shrinks in size as time separation diminishes. Mails and passengers would be the first to be served, movement of heavy goods for some time remaining in the hands of the older systems of transportation. What the world holds for us in tariff barriers in the future we do not know, but it is to be hoped that an easier, freer circulation of travellers to and from all countries will be encouraged rather than at present frowned upon by a narrow spirit of nationalism. There are also great tracts of land, rich and climatically possible, waiting to provide a happy life for

many, who at present due to lack of communications cannot live there with their kith and kin. With flight our servant, there should be no corner of the earth not readily accessible.

You may say this is post-war planning with a vengeance. To which I reply that there is no one fighting on any front who has not in his heart the idea of a fairer world afterwards where his children and for a time he himself can go about his lawful occasions.

We in Great Britain have seen a revolution take place peacefully in our land over the last twenty years. There is much more to be done. But no amount of planning of our lives and our social progress can be of value or be permanent unless we see clearly and appreciate the potential danger that man has created through the conquest of the air, and so organize the future that it is no longer a threat, but becomes the servant of man. To finish the job we have in hand and then to drift into a fools' paradise would be a tragedy little worthy of the efforts we have made to remain masters of our own destiny.

NEWS and VIEWS

Colonial Policy

MR. HAROLD MACMILLAN, Parliamentary Under-Secretary of State for the Colonies, gave an informative account of the activities and plans of the Colonial Office, in moving the vote for that Office in the House of Commons on June 24. Dealing with the present, Mr. Macmillan said the Allied losses in the Far East mean an immediate and important loss of supplies; 60 per cent of the tin production of the world, 90 per cent of the rubber production, a large proportion of the wolfram and lead, and valuable sources of sugar, tea, rice and oil seeds have fallen to the enemy. Making good the deficiencies will mean an immense increase in Colonial production. In an endeavour to bridge the gap which must occur before large-scale production of synthetic rubber in the United States can be effected, the rubber output of Ceylon has been intensified, the services of Malayan planters have been obtained to assist in reviving plantations in Tanganyika, and wild rubber in East and West Africa is being tapped. Mineral production in the Colonies is being stimulated. The Colonies are also contributing notably to the war effort by decreasing their imports. West Africa is concentrating on the production of rice, vegetables and dairy produce; East Africa is increasing its production of wheat, maize, rye and other foodstuffs. In the West Indies an attempt is being made to introduce more and diverse food crops.

Mr. Macmillan went on to speak of the future. The governing principle of the British Empire must be partnership, he said, and there must be room for the greatest divergence of local responsibility. We must begin now to prepare for changes in the organization of the Colonial Service, with two main objects. First, the civil services and the educational systems of the several Colonies must be so devised that the people are able to qualify for, and desire to serve in, the public services of their own countries. Help would still be needed from outside, however, and this could be provided by a mobile force of experts in administration, medicine, agriculture, finance, etc., at the disposal of the Secretary of State for posting to whatever Colony they are needed at a given time. In this way the present anomaly of the poorer Colonies

not being able to obtain the services of the best brains—of which they are actually in greater need than the more advanced and wealthier Colonies—would be removed. Plans are being worked out to achieve this end.

As regards questions of labour and development, Mr. Macmillan remarked that six experienced trade unionists from Great Britain have recently been appointed as Colonial labour officers to British Guiana, Trinidad, Nigeria, the Gold Coast, Sierra Leone and Palestine, to stimulate the growth of trade unionism; and twelve officers from the Ministry of Labour have been seconded for service in local labour departments. Lord Hailey, with the help of eminent men of science, will advise on the organization of research, for which £500,000 a year will be available, on health, nutrition, education, etc., and also on practical economic needs. The Colonial Development and Welfare Act provides for long-term planning, which must be used to assist the Colonies to reach present-day standards of life in the shortest possible time.

THE membership of the Colonial Research Committee referred to by Mr. Macmillan has since been announced. It is as follows: Lord Hailey (chairman); Sir Edward Appleton, secretary of the Department of Scientific and Industrial Research; Prof. A. V. Hill, secretary of the Royal Society; Sir Edward Mellanby, secretary of the Medical Research Council; and Prof. W. C. C. Topley, secretary of the Agricultural Research Council.

Part-time Employment

A PAPER on "Part-time Employment" read before the Royal Society of Arts on June 10 by F. C. Hooper, joint managing director of Messrs. Lewis's, Ltd., describes the inception and working of the part-time scheme of that firm. The details of the scheme were worked out in July and after submission to the Ministry of Labour the scheme was launched by advertisement on August 18. The appeal was addressed to married women of thirty-five and more to avoid the problem of married women with very young children, and particularly with a view to the