of the Treasury in Britain, through the University Grants Committee, and it is not improbable that the German suggestion was influenced by the British example. There is ample evidence that the latter was carefully studied.)

(6) The Council will have to smooth out inequalities and co-ordinate measures taken by the central and local governments (*Länder*, cities and districts), as regards the promotion of interest in science and research.

(7) Finally, it will be the Council's duty to scrutinize a proposal to create a central agency for the promotion of science, scholarship and research, under a federal ministry.

This is only a brief statement of the main aims for which this Council was called into being. Conditions for its proper functioning will, of course, be :

(1) The provision of adequate grants for supra-regional research institutions and projects, from the central Government and the land authorities, inasmuch as the latter cannot adequately finance them.

(2) The willingness of *Länder* governments to supplement federal funds in financing certain regional institutions.

(3) The readiness of industrial and commercial organizations to give larger sums than hitherto for the general promotion of science and for scholarships, over and above those which benefit industry directly.

(4) Parliament will have to strengthen and support the Council by accepting its advice and legislating in the light of this advice. The Council should in time achieve considerable public importance, comparable to that of the University Grants Committee.

(5) Finally, the Council should devise broad reforms for staff–student relations in institutions of higher education, for only this can ensure the vigilance necessary for 'talent-spotting' in the future.

Perhaps the most important of these points is Parliament's job of budgeting for developments in science, scholarship and technology. The first step has already been taken : annual returns have been abandoned in favour of five-year plans. A carry-over of unspent funds must obviously be permissible. Altogether, a generous, non-bureaucratic attitude seems to have been emphasized from the outset, as befits a body composed of representatives drawn from so many sources.

All members of this new Council are aware that they have to make up a good deal of lost time and, for the sake of their country's great tradition in research and scholarship, they are anxious to regain a new leading place in international science.

J. Horne

PHOSPHATES AND ORGANIC SUBSTANCES IN NITROGEN DEFICIENCY

THE International Association for Research on Phosphates, with its headquarters at 28 rue Saint-Dominique, Paris VII^e^, held its third congress at Biarritz during October 21–24. Approximately one hundred scientists and chemical engineers from twenty-three countries attended the Congress, which which was on the greater utilization of phosphates.

Communications on mining phosphate rocks, their solubility, residual effects in soils, influence in plant growth and value when incorporated with organic substances were read and discussed.

Drs. L. Schmitt (Darmstadt, president of the Association), F. Van der Paauw (Gröningen), F. Scheffer (Göttingen), L. Gisiger (Liebefeld, Switzerland), Ed. Hofman (Weihenstephan, Germany), L. Wiklander (Uppsala) and G. Barbier (Versailles) considered different aspects of the solubility of natural rock phosphates when added to soils and the phosphates present in soils under various conditions.

Drs. J. Cuzin (Paris, secretary of the Association), A. Fardy (Athens), Mme. Bireska (Warsaw), Drs. S. Nicolic (Belgrade), K. Nehring (Rostock) and M. Homes (Brussels) presented their observations on drop growth fertilized by different sparingly soluble calcium phosphates and phosphate rocks. Dr. O. Arrhenius (Grödinge, Sweden) reported a favourable effect on growth of trees when fertilized by powdered rock phosphates at the rate of one kgm. per tree.

All over the world there is a tendency towards a greater utilization of basic slag, phosphate rocks and strongly heated phosphate rocks instead of superphosphate and other soluble phosphates. This is certainly good for permanent agriculture, because the basic calcium phosphates leave a greater residual effect in soils and decrease the leaching of lime from the land. Dr. G. W. Cooke (Rothamsted) reported a more marked gain in the phosphate status of land when treated with bone meal than when superphosphate was utilized in the Saxmundham experiments over fifty-six years. It is of interest to note in this connexion that Dr. S. Nordengren (Landskrona, Sweden), the leader of the superphosphate industry in Sweden, is considering the manufacture of under-acidulated superphosphate and triple superphosphates for the market.

Interesting experiments on the solubilization of rock phosphates by the action of soil micro-organisms were described by Drs. L. Meyer and Eva Köning (Hohenheim-Stuttgart) and Dr. J. Pochon and Mlle. A. Roche (Pasteur Institute, Paris).

Dr. N. R. Dhar (Allahabad) discussed the augmentation of atmospheric nitrogen fixation in soils by incorporating different phosphates, with organic substances like green manure, farmyard manure, straw, municipal waste, leaves, grass sods, sawdust, legumes, or finely divided coal dust ploughed into the soil. He also reported that when basic slags, phosphate rocks or superphosphates are added to these organic substances during the process of composting, there is more fixation of atmospheric nitrogen in light than in the dark, and that the total nitrogen contents of the phosphated composts vary from 1·6 to 2·4 per cent as against 0·6–1 per cent present in the Indore composts of Howard. In this connexion it is interesting to record that Dr. L. Borasio (Vercelli, Italy) obtained good results in rice cultivation with a mixture of powdered rock phosphate and farmyard manure. Similar observations were described by Drs. E. Bottini (Turin) and A. Zeller (Vienna).

Recently the Soil Association at Haughley (England) obtained a yield of 30·4 cwt. of barley grain per acre by ploughing in 99 lb. phosphate per acre as basic slag mixed with barley straw. The yield with 112 lb. nitrogen as ammonium sulphate added to the same amount of straw was 20·8 cwt. per acre and in the control field containing only straw the yield was 14 cwt. per acre.

That phosphates and organic matter can fix atmospheric nitrogen in the soil and supply available nitrogen, phosphate, potash, humus and trace elements is of supreme importance in meeting the nitrogen shortage in the world (see *Nature*, **164**, 597 ; 1949).

The food production in the world is estimated to be approximately 1,100 million tons, for feeding the 2,700 million people. Out of this food, about 650 million tons consist of cereals (producing 1,100 million tons of straw containing 7–8 million tons of nitrogen) and 450 million tons of other foodstuffs. As only 25 per cent of the added nitrogenous fertilizers and manures is normally recovered in crops, and the average nitrogen content of the food materials is 2 per cent, approximately 110 million tons of fixed nitrogen seem to be necessary for the food production of the world. But chemical industry is supplying only 7 million tons per year (Table 1).

Table 1. WORLD PRODUCTION AND CONSUMPTION OF FERTILIZERS, 1955–56

Region	Production (1,000 tons)			Consumption (1,000 tons)		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Western Europe	2774·8	3352·0	3055·9	2248·9	3112·9	2639·9
United States	2033·0	2252·0	1735·0	1714·4	1989·3	1677·1
Eastern Europe	1222·7	1341·8	2113·0	1263·8	1405·9	1502·4
Far East	843·2	402·1	—	1145·0	411·9	428·3
Elsewhere	513·9	1096·5	12·1	591·2	1230·2	422·3
World total	7387·6	8444·4	6969·3	6969·3	8150·2	6670·0

It has been estimated that 4,000 million acres of land are available for cultivation in the world, and of this only 1,000 million acres are considered as first-class land. Consequently, if the fertilizers consumed in the world were evenly applied to the 4,000 million acres, each acre of land would receive 3·5 lb. nitrogen, 4·05 lb. phosphorus pentoxide and 3·3 lb. potassium oxide per year. It is an interesting coincidence that the fertilizers consumed in the United States per acre in 1956–57 are of the same order, that is, 4·2, 4·6 and 4·0 lb., respectively. Evidently these amounts are inadequate for intensive cultivation.

Moreover, the industrially under-developed countries find it difficult to construct nitrogen fixation factories. Table 2 shows the capital cost involved in the different types of ammonia synthesis plants for manufacturing 100 tons of ammonia per day.

Table 2. CAPITAL INVESTMENT (DOLLARS) FOR DIFFERENT TYPES OF AMMONIA SYNTHESIS PLANTS

Natural gas	Fuel oil	Coal	Coke oven gas	Catalytic reformer gas
3,950,000	4,098,000	4,248,000	3,620,000	2,980,000

In a study on "Observations on the Planned Provision of Nitrogen Fertilizer", Prof. Tinbergen and others of the Netherlands Economic Institute, Rotterdam, have reported that the world demand for nitrogen fertilizer in 1960–61 is expected to be 8·1 million tons (Europe, 3·1 million tons ; United States, 2·4 million tons ; other areas, 2·6 million tons). They also concluded that the consumption of nitrogen per acre of land is directly proportional to the population density of the country. This is shown in Table 3.

Table 3. NITROGEN CONSUMPTION IN 1956–57 IN KGM. PER HECTARE PER YEAR

Japan	109·6	Greece	12·1
Taiwan	86·7	Austria	11·5
Iceland	85·9	Portugal	10·5
Holland	79·0	Switzerland	10·1
Korea	54·1	Poland	10·0
Belgium	52·5	Spain	9·5
Norway	38·1	Philippines	5·6
West Germany	35·1	Czechoslovakia	5·0
East Germany	31·6	United States	4·2
Denmark	29·6	Ireland	3·2
Luxembourg	28·0	China	2·3
United Kingdom	23·5	Indonesia	2·0
Sweden	22·4	India	1·0
Ceylon	18·4	Turkey	0·4
Italy	14·7	Pakistan	0·3
France	14·4		

The average of the Organization for European Economic Co-operation area is 16·8 kgm. per hectare. It has been reported that there is shortage of chemical fertilizers in the U.S.S.R. The figures for nitrogen consumption in Table 3 show that, except in Japan, Taiwan, Belgium, Iceland and Holland, the nitrogen supply to crops as fertilizers is low. Only the countries having a large population density are compelled to use large amounts of industrial nitrogenous compounds, but not enough phosphates are used for producing the required amount of cereals. Moreover, in a recent publication (1957) on "Industrial Uses of Nitrogen" by the European Productivity Agency the following lines occur : "As world nitrogen production is outstripping the expansion of demand for traditional purposes (particularly for nitrogenous fertilizer), all producers are looking round for new outlets". It appears, therefore, that due to the high cost of nitrogenous fertilizers, farmers find it uneconomical to use the required amounts of chemical nitrogen for crop production.

The other nitrogen sources are legumes, precipitation, farmyard manure, municipal refuse and garbage. It has been reported that in the United States two million tons, and in the whole world five million tons, of nitrogen are fixed by the legumes in the soils of the Earth. Rain, snow and hail supply about 4–5 lb. per acre, that is, about 10 million tons of available nitrogen fall on the 4,000 million acres of agricultural land in the world, but a good deal is wasted as run-off. According to the U.S.A. Department of Agriculture, the world produces 1,400 million tons of manure containing 7–8 million tons of combined nitrogen, but only 15 per cent of this is actually utilized in cultivation. All over the world there is an attempt to prepare composts from city refuse and sewage sludge, which contain approximately 5 million tons of total nitrogen per year, but only a very small amount is actually reclaimed at present.

As the world reserves of phosphate rocks are not less than 21,000 million tons (United States, 7,000 million tons ; U.S.S.R., 6,500 million tons ; North Africa, 5,000 million tons ; other areas, 2,500 million tons) and the annual consumption has been estimated to be 30 million tons by R. Saint Guilhem, technical director-general of the North African Phosphate Company, the natural rock phosphates should, at the present rate of consumption, last for at least 700 years. Consequently, a much greater application of these phosphatic materials, and basic slag from the expanding world steel industry, mixed with organic waste, would be of great value to permanent agriculture in all parts of the world.

N. R. DHAR