Incubation results from this experiment were as follows:

Vessel	7	8	9	10	11	12
Bacterial growth	0	0	(+)	++	+	++
Dilution	1:7,000	1:14,000	1:28,000	1:56,000	1:112,000	1:∞

0, no growth; (+), 1-8 colonies; +, fair growth; ++, strong growth.

The effect of these unsaturated acids was different from that of the saturated ones (Fig. 1). The unsaturated acids, unlike diheptylacetic acid, regularly showed a certain limit concentration above which the oxygen consumption of the bacteria was practically abolished and below which the bacteria were unaffected. The effect is caused by the double bonds, as stearic acid was completely inactive.

The results of the incubation tests show that linolenic acid had a very strong bactericidal effect, all out of 3 mgm. bacteria being killed at 1:14,000 and almost all at 1:28,000 after eighteen hours. As will be seen from Fig. 2, the abolition of the oxygen uptake runs parallel with the bactericidal effect. The bacteriostatically most active synthetic acid of Adams *et al.* (loc. cit.) was thus in our experiments considerably less active than the common unsaturated fatty acids occurring in the body.

In five series the following dilutions were found on an average to cause abolition of the oxygen uptake of 3 mgm. bacteria in 3.5 ml. volume:

Oleic acid	..	..	1:10,000
Linoleic acid	..	..	1:15,000
Linolenic acid	..	..	1:30,000

We found that this dilution may vary somewhat with different batches of bacteria, but the relative strengths of the acids are very constant and we were able to obtain reproducible values by always including a 'standard' acid in each series. We also found that bacteria with a greater oxygen uptake are regularly less susceptible to the effect of these acids than bacteria with a small oxygen uptake.

The unsaturated fatty acids obviously get adsorbed to the tubercle bacilli. We observed that the bactericidal activity was considerably decreased in the supernatant liquid after centrifuging off the bacteria after a Warburg experiment.

In correspondence herewith there was a direct proportion between the amount of bacteria added and the quantity of fatty acid needed for the abolition of their oxygen consumption.

Addition of 0.5 ml. of blood plasma reduced the activity 4-8 times. It seems quite likely that the fatty acids are partly adsorbed on the serum proteins, thus decreasing the action on the bacteria.

We have also tested the bacteriostatic activity of the acids mentioned above with the technique of Pryce⁵ and Muller⁶. The bacteria, fixed on glass plates, were incubated for seven days in citrated blood, haemolysed by the addition of an equal volume of water, in which the compound to be tested had been dissolved. Some results are given in the following table:

Dilution	1:4,000	1:8,000	1:16,000	1:32,000	1:64,000	1:128,000	1:256,000
Di-n-heptyl-acetic acid	+	+	++	++	++	++	++
Oleic acid	-	(+)	+	++	++	++	++
Linoleic acid	-	-	(+)	(+)	+	++	++
Linolenic acid	-	(+)	(+)	+	++	++	++

-, no colonies; (+), few, small colonies; +, few colonies, but size equal to control; ++, equal to control.

As will be seen from the table, the bacteriostatic activity of di-n-heptylacetic acid is rather weak in the presence of blood. The common unsaturated fatty acids are more active also in this test. The fact that linolenic acid is less active than linoleic acid might be explained by its more rapid destruction by autoxidation during the incubation.

It seems interesting that these unsaturated acids, occurring normally in the animal body, are more active against tubercle bacilli than the most active saturated acid synthesized hitherto. It is also interesting in view of the numerous reports especially in older literature about treatment of various tuberculous lesions with soaps or oils mainly consisting of these unsaturated fatty acids⁷.

During the course of our experiments on the purification of the antibiotica against *Mycobact. tubercul.* mentioned above⁸ the Warburg technique proved to be very useful. However, it should be pointed out that the results of Davide¹ cannot be ascribed to the common unsaturated fatty acids.

¹ Davide, *Arkiv Kemi, Min., Geol.*, B, 19, No. 7 (1945).

² Kempner, *Amer. Rev. Tub.*, 46, 157 (1945).

³ Dieckmann and Menzel, *Z. Hyg. Inf. Krankh.*, 113, 709 (1932).

⁴ Stanley, Coleman, Greer, Sacks and Roger Adams, *J. Pharmacol.*, 45, 121 (1932).

⁵ Pryce, *J. Path. Bact.*, 53, 327 (1941).

⁶ Muller, *J. Path. Bact.*, 56, 429 (1944).

⁷ Lindenberg and Pestana, *Z. Immun. Forsch.*, 32, 66 (1921).

⁸ To be published later.

DISCOVERY OF ELEMENTS 95 AND 96 AND THE CHEMICAL PROPERTIES OF THE TRANSURANIC ELEMENTS

THE discovery of the elements 95 and 96 was announced on November 16, 1945, by Prof. G. T. Seaborg, of the University of California, now working at the 'Metallurgical Laboratory' of Chicago University (*Ind. and Eng. Chem.*, News Edition, 2085 and 2190; 1945). Isotopes of the two elements—as yet nameless, apparently owing to lack of 'transplutonic' planets—have been produced by bombarding uranium 238 and plutonium 239 with 40 MeV. α -particles in the Berkeley 60-inch cyclotron. Enough material has been made for chemical studies by tracer technique in the way in which the properties of element 93 (neptunium; Np) and 94 (plutonium; Pu) were first investigated in 1940. Nuclear properties of the new elements, including action of neutrons on them, are not discussed in the lecture.

According to Seaborg, the elements beginning from 89 (actinium) have a sufficiently similar electronic structure to warrant their consideration as a group ('actinide series') in the way in which the rare earths are so considered ('lanthanide series'). Although the first members of the actinide group (actinium, thorium, protoactinium, uranium) show great chemical resemblance to the elements in the vertical columns of the Periodic Table, in which they have generally so far been included (yttrium, zirconium, niobium, molybdenum, and lanthanum, hafnium, tantalum, tungsten), later members behave differently: neptunium is quite unlike rhenium, plutonium quite unlike ruthenium or osmium. Seaborg suggests that, beginning with thorium, the 5f rather

than the $6d$ shell is being filled with electrons. Hence, the characteristic oxidation state for the actinides would be III, as it is for the lanthanides. The higher valency shown by thorium, protoactinium and uranium would be comparable to the anomalous higher valency (IV) of cerium. It has, in fact, been proved that uranium, neptunium and plutonium, though all found in oxidation states III, IV, V, VI, tend more and more towards being in the lower states as the atomic number increases. Element 96 should be stable only in state III, as its electron structure is analogous to that of gadolinium. This prediction is confirmed by experiment.

Some isotopes of elements 93 and 94 are now available in quantity and can be studied by macrochemical methods. Large amounts of Pu 239 (half-life 24,000 years; used for bombs) have been extracted from carbon piles after being formed mainly by slow neutron capture in U 238, with subsequent β -decay of U 239 and Np 239, as reported before. A neptunium isotope is less easily isolated owing to the short half-life (2.3 days) of Np 239. But it is now announced by Seaborg that the α -emitting Np 237, with a half-life of 2.25 million years, is produced in carbon piles in milligram amounts in a side reaction, namely, U 238 (n , $2n$) U 237 with succeeding fairly fast β -decay of the latter to Np 237.

Some aspects of the industrial production of Pu 239 were also touched on. The Hanford extraction plant had to be designed at a time when the world stocks of plutonium were invisible to the naked eye. An expansion by the unprecedented factor of 10^{10} was involved, with the additional complication that all initial steps in a plutonium factory must on health grounds be performed by remote control. Yet the large-scale process has been a complete success from the start. In particular, 'decontamination' from active fission products is achieved to about one part in a million.

It is also mentioned that Seaborg and his group searched for neptunium and plutonium in pitchblende early in 1942, and were able to demonstrate the presence of a small amount of α -activity attributable to plutonium. The concentration was about one part in 10^{14} . The body would clearly not have been detected had not its chemical properties been known in advance. It is presumably produced by the action on U 238 of the ever-present neutrons, some of them derived from spontaneous fission of uranium.

E. BRODA.

ADMINISTRATIVE PROBLEMS OF THE UNITED NATIONS ORGANISATION

THE League of Nations has now been replaced by the United Nations Organisation; but whatever the failures of the League in the political field, the value of its achievements in the technical field has always been recognized by informed observers. One of the first tasks of the new organisation has in fact been to consider the most effective way of taking over the work which has been done in such fields as health, the control of the drug traffic and other matters which will now fall within the orbit of the Economic and Social Council. Whatever may be the future of the United Nations Organisation, it will owe much to the earlier League. Not merely is there the League's experience to draw upon but, as a recently issued

"Report on the Work of the League, 1943-1944"* shows, even during the years of war, much constructive work was being done in certain limited fields in readiness for the time when international co-operation on a far-reaching scale should again be possible.

This report of the acting Secretary-General, Mr. Sean Lester, shows how important has been the League's contribution in the non-political field and in supplying the factual basis for reconstruction. It is unnecessary here to refer to the five valuable studies on post-war economic problems published by the Economic, Financial and Transit Department during the year, in addition to the re-issue of the "Statistical Year". The same department has also assisted the United Nations Relief and Rehabilitation Administration and the Interim Food and Agriculture Commission. Marked emphasis is laid in the report on the importance of modifications taking place in the field of communications, in regard to structure and organisation, and also methods of operation, and their bearing on the general transport situation in the post-war period. The information which the department is collecting and recording regularly with particular reference to Continental Europe, for example, and the further investigation of the experience gained at the end of the First World War in approaching similar problems should be of considerable value in planning the effort for recovery that must be made. Moreover, in these investigations, which have a direct bearing on the work of the United Nations Relief and Rehabilitation Administration, account is also being taken of long-term reconstruction of means of communication and the establishment of a more fully co-ordinated peace-time transport system.

Just as the work of the Communications and Transit Secretariat has done much to provide a basis for organised collaboration in the future in the field of communications, so the Health Organisation has to a remarkable extent maintained its permanent services, such as biological standardization, epidemiological intelligence and information and documentation. The latter has been concerned not merely with epidemics but also with other health problems such as nutrition, while the Epidemiological Intelligence Service has been able to supply information and technical advice on the epidemic situation and nutritional condition of Europe to various organs of the International Red Cross. Recording the good prospects of the abolition of opium smoking everywhere after the War, the report indicates that legitimate demands for raw opium are rapidly diminishing, and that the raw opium market is likely to face a severe crisis shortly. That conclusion, and the effect of the War in stopping international co-operation concerning narcotic drugs, makes the re-establishment of control a difficult matter and gives high importance to the calling of an early meeting of the Advisory Committee of Traffic in Opium and other Dangerous Drugs.

There are still in existence and functioning the Supervisory Body and the Permanent Control Opium Board, and if the United Nations Organisation succeeds in gaining early control of the threatening situation displayed in this report it will largely be through the agencies inherited from the League.

Nor is it only by the League's own organs that its experience is being sifted and examined with the

* League of Nations. Report on the Work of the League, 1943-1944. Submitted by the Acting Secretary-General. (Official No.: C.14.M.14, 1945.) Pp. 100. (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1945.) 2s.