Any stimulus which renews vascular development, rapid absorption and mass flow of nutrients re-initiates vegetative growth. This is shown in experiments on rejuvenation by reversal of the photoperiod. Plants in blossom can usually be induced to renew growth by shifting to a vegetative photoperiod. Within two days after such alteration in the light period, there occurs a drop in transpiration, followed by increased intake of water and vegetative proliferation at stem apices.

Mobilization of organic and inorganic feed reserves in the manner described has previously been associated by other investigators (Murneek, 1925–37) with the process of fruit development. In the speaker's opinion, there is no actual discrepancy in the two points of view, nor is there any doubt about the intense food demands of enlarging fruits in heavily fruited species. Our own data merely indicate that mobilization of reserves *begins* with flower formation rather than with fruiting. This is apparently preparation for the immediate and large respiratory demands of flowering itself as well as for the heavier nutrient demands of fruit enlargement. High rates of respiration during the flowering phase temporarily deplete carbohydrate reserves, yet this very fact makes the concentration of salts at floral loci especially noticeable. On the experimental side, it is easy to miss nutrient changes which originate during flower inception because this phase is brief and soon overshadowed by events of the fruiting phase.

It is interesting to observe that as fruiting attains ascendency, there again occurs a gradual rise in rate of water absorption and the entire picture of water relations is one of better balance. Transpiration gradually subsides with onset of fruiting but ordinarily does not fall to the vegetative level. Simultaneous with the improved water balance of the fruiting phase, the flow of inorganic nutrients from root to top is accelerated. From the nutrient standpoint, conditions in the fruiting plant somewhat resemble those of the original vegetative phase except that fruits instead of vegetative structures now serve as centers of deposition. Fruit development may, in fact, be the actual inception of vegetative nutrition by the young embryos which merely employ the old sporophyte instead of the soil as a substrate.

There still remains, of course, the problem of nutrients in relation to sexual differentiation; namely, as to the factors responsible for differentiation of pistils and stamens. In this connection mineral nutrients are probably less specific in their influence than certain morphogenic inductors, like the so-called flowering hormones (Cailachian, 1937; Kiesel and Pachewitsch, 1938; Riede, 1937; Savelli, 1937) which may be a carotinoid (Murneek, 1934). But certain inorganic ions are not without effect even in this connection, as evidenced from our data on sex differentiation in dioecious forms. High nitrogen supply results in a pure stand of pistillate hemp plants, while low nitrogen produces entirely staminate plants (Tibeau, 1936). The results are not attributable to selective mortality.

Physiological studies on sex expression in hermaphroditic species are more difficult than in dioecious forms because of the close proximity of the two sex organs. This complicates disentanglement of the staminate and pistillate processes which precede the actual appearance of the sex parts themselves. Combes (1936) has recently shown that accessory floral parts supply mineral nutrients first to the developing stamen and later to the pistil (Mason and Phillis, 1936). High nitrogen content is in general associated with pistil differentiation in both dioecious and monoecious species (Howlett, 1936; Loehwing, 1933; Tibeau, 1936) while low soluble ash favors stamen inception (Stanfield, 1937).

In summary, the sequence of physiological events antecedent to and concurrent with flowering comprises, first, the change in internal water balance, followed in turn by altered translocation and redistribution of nutrients. Precise knowledge of the pattern of salt distribution aids in identification of phosphorus and nitrogen as the inorganic ions most closely associated with early phases of the transition from the vegetative to the reproductive phase. Amino compounds seem to be especially specific in their effects on sex processes, and studies are now under way to identify them and determine the precise role of commonly occurring amino acids.

PETROLEUM AND NATIONAL DEFENSE[1]

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THE United States has the largest and most efficient army of fully trained petroleum hydrocarbons of any nation in the world or any combination of nations, available for immediate service to meet any need, either peacetime or in the national defense.

With 61 per cent. of the world's total oil production occurring within this country, American technology has developed the world's most effective and, in

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[1] Address delivered at Purdue University, October 31, 1940.

many instances, only methods for maneuvering this army of petroleum hydrocarbons into the patterns which result in motor fuels and other products of a quality to more than meet the exacting requirements of high-powered engines of the most advanced design. It has applied these methods for designing petroleum molecules for quality fuels in peacetime on a scale which is not remotely approached by all other nations combined.

The United States has almost all the world's production of 100 and higher octane aviation gasoline, which supplies enormous increases in maneuverability, cruising range, lifting power and speed to airplanes with engines designed to utilize the properties of this fuel. Such production of 100 octane gasoline as there is outside the United States is by American processes, and is almost entirely concentrated within the British Empire.

The Americas control over 1.5 billion barrels out of the 2 billion yearly crude oil production—over three times as much as the rest of the world. The United States alone produces over one and one-half times as much or sixty-one per cent. of the world's total. The oil industry of the United States is ready now to produce any volume of oil for any purpose required—whether for peace or national defense. There will be no need for the gasolineless Sundays that occurred during World War No. 1. Crude oil production and refining facilities can be stepped up rapidly whenever the demand is present. Within its own borders the United States has more than enough natural gas and crude oil to produce all the aviation gasoline, motor fuels and lubricating oils for our every need. That strategic material, rubber, can be produced by the oil industry in any quantities required; this also holds true for the explosive, TNT.

Present indications are that the Axis powers might develop a real shortage of oil and lubricants for industrial, air, army and navy requirements in event of a long war. This shortage will be based upon lack of crude oil and substitute fuels, whether from hydrogenation of coal, carbon monoxide, liquefied hydrocarbon gases and gas produced from wood, coal, lignite and coke, directly on the motor vehicle. The volume of oil produced within European countries has not been sufficient to cover the amounts consumed even in peacetime.

Germany's crude oil and substitute fuels show an estimated yearly production of 49 million barrels. This represents less than two and one-half per cent. of the world's crude oil. Oil consumption in Germany and Czecho-Slovakia in 1938 amounted to 60 million barrels, a figure which in spite of curtailment of all civilian uses of petroleum can not cover the military requirements on a 1940 wartime basis. Although large volumes of stored petroleum went to the German army by the capture of a number of countries, it is difficult to estimate the amount actually falling into their hands. This is due to the unknown factor of sabotage of oil supplies by retreating armies. Air raid destruction and damage of synthetic oil plants and storage now going on has cut fuel supplies.

Italy's oil from Albania and synthetic fuels is about two million barrels a year or less than one tenth of one per cent. of the world's crude oil.

The total oil production of Austria, Hungary, Poland, France, Rumania and Czecho-Slovakia amounts to 58 million barrels or about three per cent. of the world's total.

Crude oil production in Russia is about 220 million barrels or ten per cent. of the world's total, which is probably lower than her internal demands due to industrial, army and aviation expansion.

Japan's oil production is about one tenth of one per cent. of the world's total, whereas the Dutch East Indies yields about three and one-half per cent.

England's empire has oil sources of over 150 million barrels a year from Iran, Iraq, Bahrein, Burma, Trinidad and Canada, and may draw from the 205 million of Venezuela, 39 million of Mexico and 22 million of Colombia.

Accessible to Great Britain as long as her maritime power endures are the oil fields of Central and South America, which have a yearly production of 300 million barrels or fifteen per cent. of the world's total.

The United States has an inexhaustible potential supply of natural gas, crude petroleum, coal and oil shale for the manufacture of any conceivable quantity of oil products for national defense or peacetime requirement.

No other country produces the quantities or qualities of such petroleum products as motor fuels for airplanes, pleasure cars, motor buses, tanks and tractors. Aviation gasolines of 100 and higher octane rating, solely a product of research in the United States, that give airplane maneuverability, speed of climb, shortness of take-off and dead weight lifting power are also available from this source.

Superb lubricating oils are produced for every human requirement, whether it be for lubricating fine watches or spindles, heavy duty machines or 2,000 horsepower airplane engines, four of which power the latest flying fortresses. These newer lubricants developed in the United States are not only selectively refined, but contain added chemicals which impart high film strength and give greater oxidation and sludge resistance.

Diesel oils for low- to high-speed engines are produced to fit any need of tanks, buses, trains and submarines. With the development of 100 octane motor fuels, the gasoline engine has equalled the efficiency of the best Diesels of to-day with the added advantage of greater maneuverability in airplanes and other motor vehicles.

All battleships, cruisers, transports and airplane carriers use fuel oil and lubricating oil in huge quantities, but there are no demands, even if far in excess of present requirements made upon the oil industry, which can not be fulfilled.

Petroleum gases have also come into their own in the past few years, making possible such products of military importance as alkylates, isooctane and neohexane motor fuels, which are vitally necessary as fuels for airplanes.

Synthetic rubber from petroleum is manufactured from benzene and ethylene yielding styrene, and by dehydrogenation of butane forming butadiene. The synthetic rubber has about 30 per cent. greater wearing quality and strength than natural rubber in tires now on the market. There are over 200 billion pounds of synthetic rubber potentially available from petroleum yearly.

The lower boiling hydrocarbons in petroleum from Pennsylvania, Mid-Continent, Michigan, East Texas and Kettleman Hills, California, are mostly straight-chain paraffins. Upon catalytic treatment at 932° F. and at atmospheric pressure these hydrocarbons can be converted into benzene, toluene and the xylenes. These compounds are basic materials for such high explosives as picric acid, TNT and trinitroxylenes. The quantities potentially available from the petroleum industry are at the rate of 85 billion pounds yearly. Commercial units to produce toluene and TNT from petroleum are now being installed.

In either war or peace, the United States of America has within its boundaries more than enough crude oil for complete self-sufficiency and could, if necessary, supply the petroleum products for the world's needs.

SCIENTIFIC EVENTS

UNIVERSITY COLLEGE, LONDON[1]

. . . HERE I regret to have to tell you that the college suffered badly, first by a land-mine and then by fire. The land-mine carried away the Great Hall and did a great deal of damage to roofs, windows, etc., in the main buildings of the college (apart from Foster Court which was practically untouched). The medical sciences building lost practically all its windows and the big physiology laboratory at the top of the building has lost most of its roof. A few days later there was a fire (due to incendiary bombs) which destroyed the libraries north of the main library and Flaxman Gallery, including a good many of the arts libraries and a large part of the physical sciences library. All this has meant that any attempt to carry on the teaching of medical sciences in our own building during this session is impossible. I am glad to say, however, that we have been able to make arrangements whereby the students in the faculty of medical sciences will be working in a large building near Leatherhead, which had laboratories which could be adapted for the purposes of the faculty. The staff have been indefatigable in making these arrangements and I have every hope that the continuity of our medical teaching, possibly even of some of our medical research, may be secured. Arrangements are being made to put as much of the equipment as is possible in various places of comparative safety. With regard to the rest of the college, we are removing the remainder of the library to a place of comparative safety, and have managed to redistribute the students among various colleges and universities.

The main disasters happened two or three weeks ago, and I should have written to you long since, but it was only yesterday that the Ministry of Information released the facts. . . .

At the present time, one can do little more than carry on, but we look ahead to the time when this nightmare is over and we can start to build up our work again.

DAMAGE TO SCIENTIFIC INSTITUTIONS IN LONDON

INFORMATION has recently been received from London of the bombing of the British Museum (Natural History) at South Kensington. The museum has been hit by both high explosives and incendiary bombs. The most serious damage was caused by an incendiary bomb which fell on the roof of the east wing and penetrated to the foreign herbarium of the Botany Department. A large number of plant specimens were destroyed, and many thousands of herbarium sheets were badly damaged by fire and water. It is understood that the department of entomology was also damaged. American botanists are of the opinion that many unrecognized type specimens of American and other plants were stored in the Foreign Herbarium, though a great deal of the most valuable material from several departments of the museum had been removed from London last spring. The near-by Victoria and Albert Museum has also been hit. Neither building is close to any military objective.

The London *Times* writes as follows: "The library of the Royal Society of Medicine is the finest medical library in Europe. It contains 150,000 medical volumes and provides an information service to the fel-

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[1] Excerpt from letter of the 11th of October, 1940, to Dr. Alan Gregg, from Principal Allen Mawer, of the University College, London, England.