All cold-requiring biennials, when grown close to, but slightly higher than, the known inductive temperatures, have been induced to flower with gibberellin. Similarly, long-day plants, after treatment, have flowered under short photoperiods. Exceptions have not thus far been observed. Widespread usefulness of such findings will be realized in earlier flowering for seed production and in the commercial culture of many flowering annuals and biennials.

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Stepwise Reaction on Separate Catalytic Centers: Isomerization of Saturated Hydrocarbons

In heterogeneous catalysis, a chemical reaction may proceed by creation of an intermediate product on one type of catalytic center, creating a "true"—that is, existing independently in the desorbed state—intermediate at low concentration, which is then further reacted by another type of and physically distinct catalytic center. In a previous report (*1*), it was shown how physical transport processes lead to a general criterion for required physical proximity between the two types of catalytic materials, depending on the maximum attainable vapor pressure of the intermediate.

The experimental results reported in this article present evidence that this type of mechanism is operative in the catalytic isomerization of paraffin hydrocarbons by acidic solids (for example, aluminum silicates, or halogenated alumina) impregnated with small amounts of group VIII metals (*2*).

Reaction mechanisms proposed by Mills *et al.* (*3*) have included formation of intermediate olefinic species and surface migration between metal and acidic sites. Our results confirm the hypothesis of olefinic intermediates. They furthermore demonstrate (i), their existence as a true intermediate existing in the gas phase; (ii) the ability of metal and acidic sites to act as independent, physically distinct catalysts; and (iii) the role of ordinary gas-phase diffusion of intermediates between the consecutive reaction sites in supporting the over-all reaction rate, in quantitative agreement with the criterion developed in the previous report (*1*). Specifically, the four sets of experimental results reported here support a mechanism by which the isomerization of *n*-hexane over platinum-containing silica-alumina catalyst proceeds by the mechanism

$$n\text{-Hexane} \overset{\bullet}{\rightleftarrows} n\text{-hexene} \overset{\circ}{\rightleftarrows} \text{iso-hexenes} \overset{\bullet}{\rightleftarrows} \text{iso-hexanes}$$

where the hexenes are true, low-concentration gas-phase intermediates traveling by diffusion between independent Pt (●) and "acidic" catalyst sites (○).

At 373°C, thermodynamic data (*4*) show that the thermodynamically attainable relative concentration of hexenes in *n*-hexane at 1 atm hydrogen partial pressure is 0.6×10^{-2} if all *n*-hexene isomers are produced, or 3×10^{-2} if, in addition, all methyl-pentene isomers are formed. We have passed 11 g of *n*-hexane per hour over platinum catalyst at 373°C, at 5/1 hydrogen-hexane molar ratio and at atmospheric pressure and have found, by mass-spectrometric means, the concentration of C_6 olefins produced to be 2.7×10^{-2}. This magnitude is in agreement with that attainable at thermodynamic equilibrium.

High activity of acidic oxide catalysts such as aluminum silicates to catalyze the isomerization of olefins has been reported (*5*). Over silica-alumina catalyst (422 m^2/g surface area, 11 percent by weight Al_2O_3), we have obtained 43 percent conversion of *n*-hexene to isohexenes at a space rate of 2.6 cm^3 of liquid hexene per hour, per cubic centimeter of catalyst space and at a temperature as low as 300°C.

The ability to feed the olefin isomeri-

Table 1. Cooperative action of independent Pt and acidic particles (hexane feed-rate, 26 cm^3/hr).

Charge in reactor	*T* (°C)	Conversion to iso-hexane (% wt.)
i 4.7 g Pt/silica (10 cm^3)	373	0.9
ii 7.0 g Si/Al (10 cm^3)	373	0.3
iii Mixture of i and ii (10 cm^3 of each)	373	6.8
i 4.4 g Pt/carbon (10 cm^3)	448	1.5
ii 7.0 g Si/Al (10 cm^3)	448	0.9
iii Mixture of i and ii (10 cm^3 of each)	448	6.4

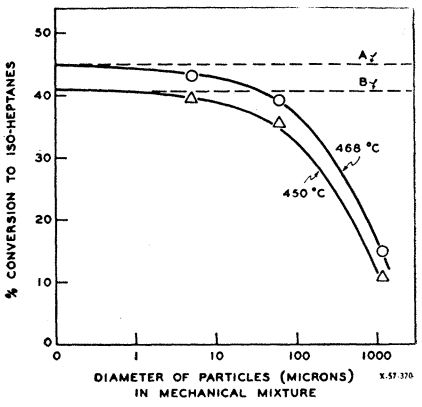

Fig. 1. Isomerization of *n*-heptane over mixtures of particles of silica-alumina and particles of inert-supported platinum. Conversions *A* (468°C) and *B* (450°C) are those obtained over platinum-impregnated silica-alumina.

zation reaction on the silica-alumina (Si/Al) catalyst particles from the low-concentration pool of olefins produced by supported platinum in the same reactor space was tested by observing isohexane production in a reactor filled with (i) inert-supported platinum, (ii) particles of silica-alumina, and (iii) a mechanical mixture of inert-supported platinum and particles of silica-alumina, both of 0.84- to 1.4-mm particle size.

Experiments were carried out using a feed rate of 26 cm^3 per hour of *n*-hexane and of hydrogen in a 5/1 molar ratio at atmospheric pressure. Results for the weight-percentage conversion to iso-hexanes in two typical experiments are shown in Table 1. The successful interaction of the two catalyst components by way of gas-phase intermediates to achieve hexane isomerization is apparent from these results.

If the entire reaction rate is thus supported by gas-phase intermediates, the criterion for a critical particle size to obtain maximum conversion will apply, as developed in the previous report (*1*). This was tested in a series of experiments with elevated hydrogen pressure, where side reactions were suppressed; this resulted in substantially clean paraffin isomerization. *n*-Heptane was passed at a space rate of 0.7 g per hour, per gram of catalyst, with hydrogen in 4/1 molar ratio, at 25 atm total pressure.

The conversion to iso-heptanes was determined by mass spectrometer analyses, when, as catalysts, mechanical mixtures of equal weights of Pt-impregnated carriers (approx. 0.3 percent by weight Pt on total mixture) and of silica-alumina (141 m^2/g surface area, 11 percent Al_2O_3) were charged to the reactor. For the 1100-μ size, a loose mixture of the component particles was charged. For the two smaller sizes, the component mixture was compressed into ⅛- by ⅛-in. cylindrical pellets. For compari-

son—that is, for maximum physical intimacy between catalytic components—an acidic base of 69 m^2/g surface area silica-alumina was used, *impregnated* with 0.2 percent Pt. Thus, the amount of "acidic" surface in the reactor was approximately the same here as with the mixtures. The thermodynamic limit to the partial pressure of *n*-heptenes is calculated to be of the order of 10^{-2} to 10^{-3} atm. For maximum reaction rate, the diffusion criterion discussed in the previous report (*1*) indicates that particle size should be less than about 100μ. The experimental results are shown in Fig. 1 and are in good agreement with this prediction, based on reaction via gas-phase olefin molecules which travel by ordinary diffusion between the two distinct types of catalytic sites.

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Infective Transfer of Maternally Inherited Abnormal Sex-Ratio in Drosophila willistoni

Deviations from the normal 1/1 ratio of sexes are known in natural populations of several species of *Drosophila*. These deviations usually take the form of production of unisexual progenies which consist mainly or exclusively of daughters. In *D. obscura, D. pseudoobscura, D. persimilis,* and *D. azteca,* this condition is inherited through the X-chromosome (*1*). On the other hand, Cavalcanti (*2*), Magni (*3*), and Carson (*4*) discovered in *D. prosaltans, D. bifasciata,* and *D. borealis,* respectively, deviations from the normal sex-ratio which appear to be inherited through the cytoplasm. Females of certain strains produce progenies that consist mainly or only of daughters, regardless of which males they are crossed to, and this condition is transmitted, in turn, to all of their female offspring. This cytoplasmically inherited "sex-ratio" condition resembles, in many ways, the oversensitivity to CO_2 that was studied by l'Heritier and his school (*5*). Recently, B. Spassky observed that a single female of *D. willistoni,* from Jamaica, and a single female of *D. paulistorum,* from Sierra Nevada de Santa Marta, Colombia, produced nearly unisexual female progenies and that this peculiarity was inherited by their offspring. Spassky has very generously given these stocks to one of us (C.M.) for study.

The "sex-ratio" condition of *D. willistoni* has been examined in some detail. Females from the "sex-ratio" strain produce nothing but daughters in outcrosses to males from most of the strains which have been tested in this respect. However, outcrosses to males from three strains collected at Recife, Brazil, from one strain from the island of Saint Lucia, West Indies, from one strain from Costa Rica, and from a laboratory strain that contains the second chromosome mutants Star, Hooked, abbreviated, and brown, produce intermediate or normal (1♀/1♂) sex-ratios after one or more generations of crossing and backcrossing. Thus, the "sex-ratio" condition is not transmitted through the usual chromosomal inheritance, but it is not independent of chromosomal genes (*6*).

Eggs deposited by "sex-ratio" females fall into two readily distinguishable classes when they are dechorionated about 2 to 4 hours after deposition. Approximately half of the eggs begin to show translucent areas, both anteriorly and posteriorly, following formation of the blastoderm. These eggs show no further normal development and yield no larvae. Presumably, they represent dying male zygotes. A fraction of eggs which appear normal in early stages produce embryos which fail to hatch and darken markedly between 24 and 36 hours after being laid. Although the sex of these embryos is not yet certain, it seems probable that they are female.

To test the possibility of the transfer of the "sex-ratio" condition to normal females, early abnormal eggs from "sex-ratio" females were punctured (about 3 to 6 hours after deposition) with a micropipette. Ooplasm was taken into the pipette and injected into the abdomens of young virgin females from the Recife strain. Uninjected females from this strain give, with great regularity, a normal 1/1 ratio of the sexes. The injected females were then mated to males of their own strain and transferred, at 2-day intervals, to a fresh culture medium. Eggs were collected in this way until the end of the life of each of the injected females. In most of the cases the broods from each of the females for the first 2 weeks of egg production yielded normal proportions of males and females. However, at the end of this period, five out of the 16 females began to produce mainly daughters, and finally they produced daughters exclusively. One of the females showed a ratio of 2♀/1♂ from the beginning and, at the end of the first 2 weeks, began to produce only females. Daughters of the injected females derived from the successive broods of eggs were then tested by mating to brothers or to males from the normal Recife strain. In the two most thoroughly tested cases of broods from the later period, when only females were being produced, 17 daughters of one injected female all showed "sex-ratio" in their progeny, 11 giving no males at all; the others, only a few males. Twelve daughters of the other injected female all gave "sex-ratio" progeny; among them were five that gave no males at all. In all cases the progenies were sufficiently large to leave no doubt of the presence of the "sex-ratio" condition in these flies. Subsequently, the F_2 daughters have produced "sex-ratio" progenies; hence, it is clear that the original infection has now been transmitted through three generations. Stocks of these new "sex-ratio" strains are now being maintained.

Examination of the eggs of the new "sex-ratio" females shows the same abnormalities that were encountered in the original "sex-ratio" strain of Jamaican origin (*7*).

A series of controls was carried out, along with the "sex-ratio" injections. For these, ooplasm of unfertilized 3- to 6-hour eggs from virgin females of the Recife strain was injected into young virgin females of this strain, by means of the same procedures that were followed in the experimental series. Broods from eggs laid at 2-day intervals were raised, and the sex ratio was determined. In none of the 15 females of this control were there any significant deviations from the normal ratio of 1/1, even after the 2-week period in which the experimental series showed the striking changes that have been described in this report.

It is therefore clearly demonstrated that the "sex-ratio" condition in *Drosophila willistoni* can be transferred to normal females, and that it is essentially infectious in nature.

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