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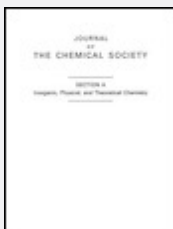
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# The preparation and properties of tris(triphenylphosphine)rhodium(I) and some reactions thereof including catalytic homogeneous hydrogenation of acetylenes and their derivatives

[J. A. Osborn](#), [F. H. Jardine](#), [J. F. Young](#) and [G. Wilkinson](#)

### Abstract

Tris(triphenylphosphine)chlororhodium(I),  $\text{RhCl}(\text{PPh}_3)_3$ , has been prepared by the reaction of rhodium(III) chloride hydrate in ethanol; the corresponding bromide and iodide complexes in various solvents has been investigated, and its reactions with hydrogen, ethylene, and acetylene studied. Dihydrido- and ethylene complexes have been isolated and studied by nuclear magnetic resonance spectroscopy. Approximate values for the formation constants of ethylene and propylene complexes are given. The rate of hydrogenation of acetylene is a factor of over  $10^3$ . By electron spin resonance spectroscopy, the complex  $\text{RhCl}(\text{PPh}_3)_3$  is a paramagnetic species, probably a rhodium(II) complex.

In homogeneous solution the tris(triphenylphosphine) complexes are exceedingly active for the catalytic hydrogenation, at *ca.* 1 atmosphere of hydrogen pressure and room temperature, of olefinic and acetylenic linkages.

The rates of hydrogenation of hept-1-ene, cyclohexene and hex-1-yne have been studied. The effect of various factors such as substrate and catalyst concentration, temperature, and pressure determined. The rate expression of the form:  $\text{Rate} = K_p [\text{S}][\text{A}] / (1 + K_1[\text{S}] + K_2[\text{S}]^2)$  where  $[\text{S}]$  and  $[\text{A}]$  are the olefin and acetylene concentrations and  $[\text{H}_2]$  is the concentration of hydrogen in solution.

From the data for cyclohexene the activation energy for the rate determining step is 12.9 kcal/mole<sup>-1</sup> and the value of  $\log k_p$  is 12.9 e.u.

It is shown that the rate of hydrogenation is independent of the deuterium content of the hydrogen gas under selected conditions. The products of the hydrogenation of olefins and, furthermore, that when  $\text{H}_2$ - $\text{D}_2$  mixtures are used in the hydrogenation of olefins, the major products are the deuterated compounds. Reductions of maleic and fumaric acids with deuterium shows that the major product is the deuterated compound. In the reduction of hex-2-yne to n-hexane, *cis*-hex-2-ene is found to be the major product.

A mechanism for the hydrogenation is proposed in which the metal complex serves and an olefin molecule are briefly co-ordinated before transfer of one to the other to  $H_2$ /rate  $D_2 = 0.9$ ) suggests that synchronous breaking of Rh-H bonds and making state involving two simultaneous three-centre interactions.

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The first part of the document discusses the importance of maintaining accurate records in a laboratory setting. It emphasizes the need for clear labeling and organization of samples to ensure that data is reliable and reproducible. The text also touches upon the ethical considerations of data handling and the responsibility of researchers to report findings honestly.

In the second section, the author delves into the technical aspects of data collection and analysis. This includes a detailed description of the instruments used, the calibration procedures, and the statistical methods employed to interpret the results. The author provides a step-by-step guide to the data processing workflow, from raw data acquisition to the final publication-ready figures.

The third part of the document focuses on the challenges of working with complex datasets. It discusses strategies for managing large volumes of data, ensuring data integrity, and identifying potential sources of error. The author also shares insights into the collaborative nature of scientific research, highlighting the importance of communication and teamwork in overcoming obstacles.

Finally, the document concludes with a reflection on the broader implications of the research. It discusses how the findings contribute to the field and what future studies might be needed to further explore the phenomena under investigation. The author expresses a commitment to ongoing learning and improvement in their research practice.

the 1990s, the number of people with a mental health problem has increased by 25% (Mental Health Foundation 2002). The number of people with a mental health problem in the UK is estimated to be 6.5 million (Mental Health Foundation 2002). The prevalence of mental health problems is increasing in all age groups, but the increase is most marked in young people (Mental Health Foundation 2002).

There is a growing awareness of the need to address the mental health needs of young people (Mental Health Foundation 2002). The UK Government has set a target to reduce the number of young people with a mental health problem by 20% by 2010 (Mental Health Foundation 2002). The UK Government has also set a target to reduce the number of young people with a mental health problem who are in hospital by 20% by 2010 (Mental Health Foundation 2002).

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the 1990s, the number of people in the UK who are employed in the public sector has increased from 10.5 million to 12.5 million, and the number of people in the public sector who are employed in health care has increased from 2.5 million to 3.5 million (Department of Health 2000).

There are a number of reasons for this increase in the number of people employed in the public sector. One reason is that the public sector has become a more important part of the economy. Another reason is that the public sector has become a more attractive place to work. A third reason is that the public sector has become a more important part of society.

The public sector has become a more important part of the economy because it provides a number of essential services. These services include health care, education, and social services. The public sector also provides a number of other services, such as housing and transport.

The public sector has become a more attractive place to work because it offers a number of benefits. These benefits include a secure job, a good pension, and a good work-life balance. The public sector also offers a number of other benefits, such as a good salary and a good working environment.

The public sector has become a more important part of society because it provides a number of essential services. These services include health care, education, and social services. The public sector also provides a number of other services, such as housing and transport.

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