### Major Upjohn researchers (team leaders) of the work presented in this nomination

<table>
<thead>
<tr>
<th>Researcher</th>
<th>Overview of Contribution</th>
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<tbody>
<tr>
<td>George Cartland, PhD</td>
<td>1930’s-1940’s - developed a method of manufacturing a stable extract of adrenal cortex extract activity, which was marketed in 1935 as ACE. Their analytical unit of measure for adrenal hormone potency, the Cartland-Kuizenga unit, became the worldwide standard.</td>
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<tr>
<td>Marvin Kuizenga, PhD</td>
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<td>Frederick Heyl, PhD</td>
<td>1949 - developed commercial chemical synthesis process for converting stigmasterol to progesterone</td>
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<td>Milton Herr, PhD</td>
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<td>Herbert Murray, PhD</td>
<td>1952 - discovered microbiological route for oxygenating progesterone to hydroxyprogesterone, opened the door for low-cost synthesis of cortisone</td>
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<td>Durey Peterson, PhD</td>
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<td>W.J. Haines, PhD</td>
<td>1952 - discovered microbiological route for oxygenating Reichstein’s Compound S to hydrocortisone</td>
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<td>B.J. Magerlein, PhD</td>
<td>1952-1954 - developed commercial direct synthetic process for converting hydroxyprogesterone to hydrocortisone and cortisone</td>
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<td>W.P. Schneider, PhD</td>
<td>1956 – developed counter-current processing method for extracting corticosteroid manufacture staring materials stigmasterol and sitosterol from soy sterols</td>
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<td>J. Ward Greiner</td>
<td>The combined work of these scientists reduced the synthesis of cortisone from Merck's 37 steps to 11 steps from an abundant sterol, stigmasterol, reducing the selling price about 100-fold and allowed Upjohn to dominate the market.</td>
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<td>John Hogg, PhD</td>
<td>1950’s – 1960’s – developed commercial routes next generation corticosteroid products. The combined work of these scientists lead to commercialization of cortisone-analogue, next generation steroids, which became even more important medicines than cortisone, boosting Upjohn into becoming the largest steroid producer in the world.</td>
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<td>Frank Lincoln, Jr., PhD</td>
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<td>George Spero, PhD</td>
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<td>W.E. Dulin, PhD</td>
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<tr>
<td>Merle Wovcha, PhD</td>
<td>1974 – discovered microbiological route for converting sitosterol to hydroxyandrostenedione, opened the door for sitosterol to become another starting material for steroid synthesis</td>
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<td>Verlan Van Rheenan, PhD</td>
<td>1974-1990 – developed commercial routes for converting androstenediones into useful steroid manufacturing intermediates and products. The combined work of Wovcha and these scientists expanded even further the Upjohn steroid portfolio.</td>
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<td>E.J. Hessler, PhD</td>
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<tr>
<td>Doug Livingstone, PhD</td>
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</table>
Major patents granted for the work presented in this nomination

US 2,601,287 – Partial synthesis of progesterone
Inventors: Frederick Heyl, Milton Herr
Filed: 18 Aug 1949, Granted: 24 Jun 1952

US 2,602,769 – Oxygenation of steroids by Mucorales fungi
Inventors: Herbert Murray, Duey Peterson
Filed: 23 Feb 1952, Granted: 8 Jul 1952

US 2,649,401 – Steroid oxidation
Inventors: W. Haines, D. Collingsworth
Filed: 16 Sep 1950, Granted: 18 Aug 1953

US 2,670,358 – 14-alpha-Hydroxyprogesterone
Inventors: Herbert Murray, Duey Peterson
Filed: 28 Aug 1952, Granted: 23 Feb 1954

US 2,715,621 – Steroids
Inventors: Philip Beal, John Hogg, Frank Lincoln Jr.
Filed: 30 Mar 1953, Granted: 16 Aug 1955

US 2,751,402 – Oxidation of hydrocortisone esters to cortisone esters
Inventor: William Schneider
Filed: 13 Aug 1953, Granted: 19 Jun 1956

US 2,759,004 – Recovery of oxygenated steroids from aqueous fermentation media
Inventors: S. Eppstein, Hazel Marion Leigh
Filed: 13 Aug 1953, Granted: 15 Aug 1956

US 2,839,544 – Countercurrent extraction of steroids
Inventors: John Ward Greiner, Glen Fevig
Filed: 4 Sep 1956, Granted: 17 Jun 1958

US 2,875,200 – 9α-Halo-11β,21-dihydroxy-4,17(20)-pregnadiene-3-one compounds and process of preparing thereof
Inventors: John Hogg, Frank Lincoln Jr.
Filed: 17 Dec 1954, Granted: 25 Feb 1959

US 2,897,217 – 6-Methyl analogues of cortisone, hydrocortisone and 21-esters thereof
Inventor: George Spero
Filed: 23 Nov 1956, Granted: 28 Jul 1959

US 2,897,218 – 6-Methyl-1-dehydro analogues of cortisone, hydrocortisone and 21-esters thereof
Inventors: Oldrich Schek, George Spero
Filed: 23 Nov 1956, Granted: 28 Jul 1959
US 2,923,720 – 2-Lower-alkyl pregnanes and process thereof
Inventors: Frank Lincoln Jr., John Hogg
Filed: 31 Jan 1955, Granted: 2 Feb 1960

US 3,359,287 – 16-Methylene-17α-hydroxy progesterones and derivatives thereof
Inventors: John Babcock, J. Allan Campbell
Filed: 16 Nov 1959, Granted: 19 Dec 1967

US 4,035,236 - Process for preparing 9α-hydroxyandrostenedione
Inventor: Merle Wovcha

US 4,102,907 – Disulfinylation process for preparing androsta-4,9(11)-dien-3,17-dione
Inventor: Kenneth Shephard
Filed: 7 Mar 1977, Granted: 25 Jul 1978

US 4,216,159 – Synthesis of 16-unsaturated pregnanes from 17-keto steroids
Inventors: Edward Hessler, Verlan Van Rheenan
Filed: 25 May 1978, Granted: 5 Aug 1980

US 4,345,029 – Mycobacterium Phlei mutants convert sterols to androsta-1,4-diene-3,17-dione and androsta-4-ene-3,17-dione
Inventors: Merle Wovcha, C. Biggs
Filed: 8 Sep 1980, Granted: 17 Aug 1982

US 4,977,255 - Steroidal 17α-silyl esters and process to corticoids and progesterones
Inventors: Douglas Livingston, Bruce Pearlman, Scott Denmark
Filed: 5 Nov 1987, Granted: 11 Dec 1990
Major references providing the information in this nomination


## Corticosteroid

- Betamethasone
- Betamethasone Phosphate
- Betamethasone Valerate
- Cortisone Acetate
- Dexamethasone
- Dexamethasone Acetate
- Dexamethasone Phosphate
- Fludrocortisone Acetate
- Fluorometholone
- Hydrocortisone
- Hydrocortisone Acetate
- Hydrocortisone Hemisuccinate
- Prednisolone Anhydrous
- Prednisolone Hydrate
- Prednisolone Acetate
- Prednisone
- Prednisone Acetate
- Triamcinolone
- Triamcinolone Acetonide

## Antibiotics

- Erythromycin
- Erythromycin Stearate
- Erythromycin Ethyl Succinate
- Neomycin Sulfate
- Novobiocin

## Hormones

- Ethisterone
- Hydroxyprogesterone Caproate
- Methyltestosterone
- Progesterone
- Testosterone
- Testosterone Cyponate
- Testosterone Enanthate
- Testosterone Propionate

## Sterols

- Sitosterol
- Stigmasterol

## Specialty Chemicals

- Cycloheximide
- Streptozocin

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**Major Steroids and Intermediates Manufactured by The Upjohn Company (1987)**