CHAPTER - 1

INTRODUCTION
Natural product chemistry is essentially a part of Organic Chemistry, itself one of the most remarkable of all the sciences and one which is usually regarded by the layman as one of the most abstruse and remote from everyday life and thought. It is hard to believe, however, that a science can properly be described as abstruse which permeates almost every material aspect of modern civilization. It stands as the bridge linking the physical with the biological sciences, and which is perhaps the biggest of the sciences, in its factual content and in the number of its adherents.

The original impetus to natural products chemistry, undoubtedly came from medicines and the use of natural drugs in its practice. Already in the eighteenth century what we may describe as scientific medicine was under way and drugs, such as extracts of Digitalis and Cinchona were being used rationally. First the pharmacists and then the chemists, actuated by curiosity or by the prospect of financial reward, began to busy themselves with the extraction and purification of natural drugs known to be of value and to study their chemistry.

Direct study of substances found in living matter or more briefly, of natural products, is as old as chemistry itself,
although it has only become a dominant feature of the science during the present century. The fact of the development of natural product chemistry became a prominent feature of organic chemistry during the first thirty years of this century. It was effectively during this period that the broad features of the essential oils were worked out by Perkin and Wallach et al.; Willstatter's studies on chlorophyll and on the nature of enzymes were carried out. Emil Fischer made his investigations into the proteins and carbohydrates. Perkin and his brilliant pupils Thrope, Simonsen, Haworth and Robinson greatly extended the knowledge of terpenes, natural colouring matters, alkaloids and carbohydrates. Around 1930, a new interest began to appear in structure in relation to function among natural products which has brought organic chemistry much closer to biology than it has ever been before.

The older type of structural study applied to the isolated plant products is no longer a spearhead in the advancement of the sciences, but this does not mean that it has everywhere lost its importance from a practical standpoint. We have seen the medical value and industrial stimulus provided by such a natural alkaloids as 'reserpine' isolated from plant material for long used in oriental folk medicine. It is likely that still other substances with significant and valuable pharmacological properties remains to be isolated from plant materials and that, incidently clues to some of them may still be found in the folk medicine of primitive people. There are
ample proof for the application of the crude plants extracts and decoctions in therapy of world over as well as in India. But the rationalization of the science of therapeutics as we know is comparatively of recent origin. Chemical investigation along-with pharmacological examination of the chemical constituents from plants of medicinal value has gained much importance in the therapeutical world. This idea has encouraged me to take up the phytochemical and biological investigations incorporated in this thesis.

Phytochemistry has not only enriched modern medicine but has also provided valuable leads for drug designing. The medicinal properties of plants depends upon the presence of pharmacological and physiological active compounds. Therefore, it becomes necessary to isolate the active compounds from plants in pure form and to study their structures by means of physico-chemical examinations and then subject them to pharmacological and physiological tests. Further by slightly modifying the composition of natural drug it may be possible to increase the physiological activity of the drug.

Since the dawn of human creation, man had to suffer from various ailments and diseases. His worries to be relieved of diseases led to search of remedies that could provide cures for them. His attention was naturally diverted towards the plant since they were easily and abundantly available. The search for medicinal plants have continued through centuries. It goes to credit of the people of India that they were
acquainted with a far larger number of medicinal plants than the natives of any other country on the face of the earth.

The plants and their products are the greatest gift of nature for the service of mankind. The use of plants to prevent and cure diseases goes back in the history of man\(^1\). A transition from primitive to rational medicine is evident from the documents, many of which are of great antiquity and reveal that a large number of herbal and aromatic plants have been used in India. With the growth of civilization the multiferous uses of plant products began to appreciated and in the course of time, their uses in medicine, flavours, perfumes, dyeing, cosmetics, edible fats etc. developed.

The isolation of active principles which possess the physiological and pharmacological activity from the medicinal plants and their successful utilization to alleviate human suffering have encouraged researchers to continue the investigation of new drugs from natural sources. The history of indigenous drugs in India can be traced from the "RIGVEDA", the oldest reservoir of human knowledge particularly in "AYURVEDA".

Various plant products possess significant physiological and pharmacological activities for example cytotoxic active compounds isolated from *Ipomosis aggregata* showed anti-cancerous activity against KB cell culture\(^2\). The bark of *Diospyros montana* Roxb. has been investigated to establish anti-tumour activity\(^3\). Oil of *Hydnocarpus wightiana* is used as remedy for the treatment of leprosy\(^4\). The methanolic extract of the
stem of *Ocharosia acuminata* showed potent antileukemic activity
*in vivo* against P-388 lymphocytic leukemia growth at T/C > 180%
(50 mg/kg)\(^5\). The methanolic extract of the roots of
*Morus indica* found to possess CNS depressant, analgesic and
significant local anaesthetic actions\(^6\). *Hypnea musciformis*
*wulfen* showed antispasmodic activity and anti-inflammatory
activity against rats hind paw oedema induced by commercial
carrageenan\(^7\). *Pterocarpus marsupium* Roxb. is advocated for
the treatment of diabetes millitus in Indian medicine and
hypoglycemic activity in normal and alloxanised albino rats\(^8\).
*Rauwolfia serpentina*, which is found particularly in India,
that was used for centuries in folk medicine "for all the ills
of man" used for epilepsy, insomania and insanity, dysentery,
diarrhoea and cholera, headache, blindness and applied as
an antidote for insects and snake bites\(^9\). The fruits of
*Ammi majus* Linn. have long been used by the Egyptians for
the treatment of leucoderma\(^9\). Rutin, a well known glycoside,
originally derived from *Ruta graveolens* Linn., is employed
in the treatment of capillary fragility and in the treatment
of the after effect of exposure to atomic radiations\(^9\).

The great diversity and complexity of the chemical
nature of the natural products and their presence some times
in very poor amounts in plants, provide a major obstacle in
the progress of the phytochemistry. However, the availability
of the modern physico-chemical techniques such as TLC, GLC,
UV, IR, NMR, Mass and ESR spectroscopy etc. has helped the
chemists to determine the structure of constituents from the
plants. It has now become possible for an organic chemists to investigate successfully the various biological compounds even if they occur in very small amounts. This has given a significant impetus to the development of drugs from plant sources.

The references\textsuperscript{10-15} relating to the isolation and study of natural products by the use of different chromatographies will indicate the importance of this particular technique.

Paper electrophoresis is now being increasingly used in the separation of alkaloids and various other plant products. The references\textsuperscript{16-18} of the work in which this technique has been employed to reveal its importance.

UV, IR, NMR and Mass spectroscopy are the modern tools for the phytochemists. Their importance are evident from the references\textsuperscript{19-25}.

X-rays analysis plays an important role in establishing the structure of higher molecules such as alkaloids, sterols, mucilages, tannins, waxes and essential oils\textsuperscript{26,27}.

Unfortunately a single test can not be applied for the determination of the medicinal value of the plants. A test for antibacterial activity for example will not reveal the presence of substance possessing narcotic effect or having action on the heart. There are certain constituents like 'Hashish' and 'Opium' which are not distributed in the plant tissues uniformly. Further, it is also possible that substance may
not be present in the plant at all the stages of its growth. Climatic conditions also effect the chemical constituents in the plants.

A systematic examination of the plants for getting the new drug is obviously an arduous task for the plant biochemists. Nevertheless, many notable successes already recorded to give encouragement for the continuation of the work. Plants and other natural sources can provide thousand of substances of which a few can reasonably be considered useful as drugs, which will not be provided by the chemists for years to come. Thus the science of medicine has developed on the basis of curative and preventive properties on diseases of different plant products. This was the main reason for investigation of all the types of plants for achieving success in the utilisation of natural products for benefit of mankind.

The most common biologically active constituents of plants fall under the following groups of compound -
(1) Glycosides  (2) Tannins  (3) Alkaloids  (4) Steroids
(5) Enzymes  (6) Proteins and Amino acids  (7) Flavonoids
(8) Saponins and Sapogenins  (9) Terpenoids  (10) Lactones
and Coumarins  (11) Anthraquinones  (12) Carotenoids
(13) Fatty acids and (14) Esters etc.

The description of all the groups of the organic substances mentioned above is not possible and is beyond the scope of this thesis. However, a brief description of the sterols, terpenes, anthraquinones, coumarins and esters have
been given here as the author has been engaged mainly in the study of compounds belonging to these groups.

**STEROLS**

Sterols are polycyclic, hydroaromatic secondary alcohols and may occur in the free state, glycosides or as esters. Invariably they occur whenever life exists and are found associated with fats and oils of both vegetables and animal origin.

The sterols have been mainly divided into three groups according to their occurrence: (1) Zoo-sterols, obtained from animal (2) Phyto-sterols, obtained from plant kingdom and (3) Myco-sterols, obtained from micro-organisms including fungi.

Sterols have been divided into various groups according to their structural pattern in their skeleton as given below:

<table>
<thead>
<tr>
<th>Series</th>
<th>Ring A/B transfused</th>
<th>Rings A, B and C are fused</th>
</tr>
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<tbody>
<tr>
<td>C 19</td>
<td>Androstane</td>
<td>Ia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iso-androstane</td>
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<tr>
<td>C 21</td>
<td>Allopregnane</td>
<td>Ib</td>
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<tr>
<td></td>
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<td>Pregnane</td>
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<tr>
<td>C 24</td>
<td>Allocholane</td>
<td>Ic</td>
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<td></td>
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<td>Cholane</td>
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<td>C 27</td>
<td>Cholastane</td>
<td>Id</td>
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<td></td>
<td></td>
<td>Co-prostane</td>
</tr>
<tr>
<td>C 28</td>
<td>Ergostane</td>
<td>Ie</td>
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<tr>
<td></td>
<td></td>
<td>Co-proergostane</td>
</tr>
<tr>
<td>C 29</td>
<td>Stigmastane (Sitostane)</td>
<td>If</td>
</tr>
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<td></td>
<td></td>
<td>Co-prositostane</td>
</tr>
</tbody>
</table>
(a) \( R = H \)
(b) \( R = -\text{CH}_2\text{-CH}_3 \)
(c) \( R = -\text{HC-CH}_2\text{-CH}_2\text{-CH}_3 \)
(d) \( R = -\text{CH-CH}_2\text{-CH}_2\text{-CH}_3 \)
(e) \( R = -\text{CH-CH}_2\text{-\{(CH}_2\text{)}_2\text{-CH}_3 \)
(f) \( R = -\text{CH-(CH}_2\text{)}_2\text{-CH}_3 \)

**PHYSIOLOGICAL ACTIVITY OF THE STEROIDS**

Sterols seem to have an important function in animal metabolism as hormones, co-enzymes, bile acids and vitamin D. \( \beta \)-sitosterol shows significant antipyretic and anti-inflammatory activities.\(^{29} \).
TERPENOIDES

The terpenoids represent a compound which has a carbon skeleton (i) either constructed directly from isoprenoid units (\(\text{C}_{\text{C}}\text{C}_{\text{C}}\text{C}_{\text{C}}\)) or (ii) has at some stage in its biogenesis a carbon skeleton so constructed.

Terpenoidal chemistry has an attraction for the organic chemists because of its use in the preparation of perfumes, flavours, protective coatings, pharmaceuticals, insecticides and condensation catalysts etc.

Terpenes are classified as: monoterpenes \((\text{C}_{5}\text{H}_{8})_2\); sesquiterpenes \((\text{C}_{5}\text{H}_{8})_3\); diterpenes \((\text{C}_{5}\text{H}_{8})_4\); triterpenes \((\text{C}_{5}\text{H}_{8})_6\); tetraterpenes \((\text{C}_{5}\text{H}_{8})_8\) and polyterpenes \((\text{C}_{5}\text{H}_{8})_n\). Most of the known triterpenoids have been found to have either tetracyclic or pentacyclic structure.

Triterpenoids have skeleton consisting of thirty carbon atoms assumed to be divisible into six isoprene units. Since \(\text{C}_{25}\) terpenoids are not found in nature, there is a great increase in structural complexity on going from the di-terpenoids to the triterpenoids. No triterpenoids has so far been found to have a monocyclic or bicyclic structure. Tricyclic triterpenoids are also rare and one important compound in this group is the "ambrein".
PENTACYCLIC TRITERPENOIDS

Pentacyclic triterpenes occur in the plant as a glycoside (saponin) or as a free form. The non-glycosidic triterpenoids are frequently found as excretions or in the cuticles, where they may have a protective or water proofing function. This class can further be divided into three series on the basis of chemical structures.
(1) Oleanane (e.g. β-amyrin); (2) Lupane (e.g. Lupeol); and (3) Ursane (e.g. α-amyrin).

The oleanane, lupane and ursane series are of the most wide spread of pentacyclic triterpenes found in the nature. The other series are the hopane (e.g. mollugogenol); Friedelane (e.g. friedelinol) and teraxerane (e.g. taraxerol). The nor groups of these series are of rare occurance in nature for example nor-lupane and nor-oleanane.
PHYSIOLOGICAL ACTIVITY OF THE TERPENES

Triterpenoids have been observed to have very interesting physiological activities. Helvolic acid, cephalosporin and fusidin with penicillin shows a remarkably high anti-staphylococcal activity. Glycyrrhetic acid is used in the treatment of Addison’s disease, asiaticoside, leprosy and tuberculosis. Two new pentacyclic triterpenes isolated from Agauria salicifolia are responsible for curare like activity. The cucurbitacin-E shows tumor inhibiting and anti-cancerous properties. Nimbin shows potent anti-inflammatory, antipyretic and analgesic activity. Isohelenalin and isohelenol, sesquiterpene lactones, isolated from Helodium microcephalum, showed antileukemic activity. α- and β-amyrin acetates both have anti-inflammatory activity. Lupeol acetate, ursolic acid and taraxerol have anti-ulcer activity. Limonoids reported recently in the Mella azedarach showed antimicrobial and antileukemic activities. The triterpenes reported in the plant, Inonotus obliquus exhibited antitumor activity.
QUINONES

The quinones constitute an important class of naturally occurring pigments, about fifty percent of which are known to occur in higher plants. The pigments are mainly present in leaves, bark and to certain extents in other part of the plants. Over fifty quinones have been isolated from micro-organisms, particularly in lower fungi and a few are in lichens. They usually occur in the form of glycoside and occasionally in the free state. Structurally they are related to benzoquinones, naphthoquinones or anthraquinones. In some cases miscellaneous complex structure are present e.g. alphin pigments\(^{41}\) elaborated by insects. Among those the pigments related to anthraquinone constitutes the largest group\(^{42}\). About half of the total numbers occur in the plants of "Rubiaceae family" which were studied intensively by Perkin et al.\(^{43}\) and the remaining are mostly the fungal product studied mainly by Raistrick\(^{44}\) and Shibata\(^{45}\).

The quinones are coloured dioxo derivatives of dihydro aromatic systems, the oxygen atom occupying positions which are either ortho or para (or their equivalent polycyclic compounds) to each other. The quinonic pigments are distinguished from other group of pigment by their oxidoreductive nature and the distinct colouration given by the addition of caustic alkali or concentrated sulphuric acid. Magnesium acetate exhibits beautiful colouration with \(\alpha\)-hydroxyquinone in alcoholic solution. This colour reactions suggest the relative
positions of the substituted hydroxyls on the anthraquinone nucleus e.g. 1,4-dihydroxyanthraquinone (orange) and 1,2-dihydroxy anthraquinone (blue)\textsuperscript{42}. All the anthraquinones so far isolated from lichen give an orange colouration with magnesium acetate showing the meta-substitution of the hydroxyls.

Anthraquinones occur as complex mixture which can be separated either by the use of different solvents or by the use of chromatographic method employing magnesium carbonate, magnesol, magnesium oxide, silicic acid and silica gel as adsorbents. Paper and thin layer chromatographies have also been occasionally employed for the separation and characterization of these compounds.

Spectroscopic techniques have been extensively used for the study of anthraquinones. UV and IR spectral investigation on anthraquinones have been performed by various workers\textsuperscript{46-48}.

Some of the recently investigated anthraquinones are: anthraquinoid pigments of Japanese Rubia cardifolia\textsuperscript{49}; bianthraquinones from Cassia sclamea Lam.\textsuperscript{50}; everythrin, an anthraquinoid from Aspergillus versicolor\textsuperscript{51}, new anthraquinone pigments from the stem bark of Melia azedarach Linn.\textsuperscript{52}, new glycosides from the stem bark of Aphanamixis polystachya\textsuperscript{53}, anthraquinone from stem bark of Maesopsis eminii\textsuperscript{54}, a new anthraquinone from the stem bark of Diospyros discolor\textsuperscript{55}, new anthraquinones from the seeds of Peganum harmala\textsuperscript{56,57}; new
anthraquinone, eugnone, from the stem bark of *Sapium eugenifolium* and new anthraquinone from the roots of *Morinda citrifolia*.

**PHYSIOLOGICAL ACTIVITY OF THE QUINONES**

Many natural quinones and quinols have antibiotic properties and this is probably important in some cases to protect the surrounding tissue against invading microorganisms. The mode of action appears to be complex.

Several pungent substances of the quinone group cause a more or less marked irritation of the mucous membranes. Plumbagin, a hydroxymethyl naphthaquinone from the root bark of *Plumbago rosea* previously used in India as a medicine under the name of 'Chita' is fatal to roots, guinea-pigs and frogs because of its action upon respiratory system. Perezone, obtained from the roots of *Radix pereziae*, embelin from the fruits of *Ribes embella* and juglone from unripe walnut shell of *Juglans regia* are violent purgative.

Anthraquinone glycosides are important cathartic compounds. They are used as purgative and are widely employed in geriatric and pediatric medicine for their unique pharmacological effects.
COUMARINS

Coumarins are naturally occurring compounds. Since 1820, when Vogel for the first time isolated coumarin, the parent compound, present in the seeds of Coumarona odorata from which its name is derived. More than six hundred compounds of the type have been reported from plant and animal sources, and metabolite products of bacteria and fungi. About half of them have been isolated from plants of families mainly Umbelliferae, Gramineae, Orchadaceae, Leguminosae, Guttiferae, Labiatae and other families of lesser importance. Coumarins are found to occur either in the free or in combined condition in different parts of the plants.

The fusion of a pyrone ring with a benzene nucleus give rise to a class of heterocyclic compounds known as benzo-pyrones, of which two distinct types are recognised: (i) benzo-α-pyrone, commonly known as coumarin and (ii) benzo-y-pyrone called as chromones, the latter differing from the former only in the position of carbonyl group in the heterocyclic ring.

\[
\text{Benzo-α-pyrone} \quad \begin{array}{c}
\text{Benzo-y-pyrone}
\end{array}
\]
Coumarins can be classified as follows:

1. Simple coumarins are umbelliferone derivatives substituted in benzene ring only.

2. Furanocoumarins have a furan ring fused with the benzene ring in coumarins (linear and angular).

3. Pyranocoumarins have a pyrone ring fused with benzopyrone system involving C-7 oxygen atom.

4. Abnormal coumarins are simple coumarin substituted in the pyrone ring.

5. Bicoumarins and tricoumarins.

A substantial monograph on coumarins is available.\(^{67}\) Besides UV, IR, \(^1\)H-NMR spectra, the \(^{13}\)C-NMR spectra of coumarins and substituted coumarins have also been analysed.\(^{68}\)

Osthole, ostenol, ostruthin, ammoresinol are examples of the group of hydroxy and methoxy coumarins with alkyl or alkylenic group. Siderin is a polyketide derived compound which has been isolated both from plant (\textit{Cedrela toona})\(^{69}\) and fungal (\textit{Aspergillus variecolor})\(^{70}\) sources. Katanin\(^{71}\), a dimer of siderin has been isolated from a toxigenic strain of \textit{Aspergillus glaucus}.

\[\text{Siderin}\]

\[\text{Katanin}\]
Various furanocoumarins have also been reported in nature. Bergapten (bergapten), xanthotoxin, isopimpinellin, imperatomin, peucedanin have the basic structure of 6,7-furanocoumarin (psoralene). Psoralene\textsuperscript{72} which is an isomer of angelicin was first isolated from the seeds of Indian plant \textit{Psoralea corylifolia} alongwith angelicin.

\begin{center}
\includegraphics[width=0.5\textwidth]{psoralene_angelicin.png}
\end{center}

Psoralene  
Angelinc

The most widely studied group of coumarins are the aflatoxins\textsuperscript{73}, e.g. aflatoxin B\textsubscript{1} a group of mycotoxins produced by the common moulds \textit{Aspergillus parasiticus} and \textit{Aspergillus flavus}. Aflatoxin M\textsubscript{1}, a metabolite of aflatoxin B\textsubscript{1} is commonly detected in milk and its synthesis has been reported\textsuperscript{74}.

\begin{center}
\includegraphics[width=0.5\textwidth]{aflatoxin.png}
\end{center}

\begin{center}
Aflatoxin B\textsubscript{1} : R = H  
Aflatoxin M\textsubscript{1} : R = OH
\end{center}

\textbf{PHYSIOLOGICAL ACTIVITY OF THE COUMARINS}

Coumarins have been found to be physiologically active for animals as well as men. The physiological activities
and structural elucidation of number of naturally occurring coumarins have been reported in literature\textsuperscript{75-78}. Some examples of specific coumarins are: Bergaptol, the active constituent of the oil obtained from \textit{Citrus bergamia}, the roots of which is used by the natives of the Togos as an abortifacient and as fish poison\textsuperscript{61}. Xanthotoxin is an active fish poison and like bergapten affects the central nervous system\textsuperscript{61}. Pimpinellin and isopimpinellin isolated from \textit{Pimpinella saxifraga} are fish poison\textsuperscript{61}.

Werder has synthesised over hundred derivatives of coumarin-3-carboxylic acid (these acids have not yet been found to occur in vegetable kingdom)\textsuperscript{66}. He has investigated the utility in medicines. They are sedative in small doses and hypnotic in large doses.

Quite often coumarin is used in industrial products such as printing inks, insecticides, paints and synthetic rubber to mask disagreeable odours\textsuperscript{66}.
ESTERS

An ester can be regarded as a compound formed by the replacement of acidic hydrogen of an inorganic or organic acid by an aliphatic, aromatic or heterocycle radical. The word 'ester' generally has the connotation of a substance prepared from a carboxylic acid and an alcoholic or phenolic hydroxy compound. Organic esters of this type are represented by the general formula:

\[ \text{R} - \text{C} - \text{O} - \text{R} \]

The common esters are named in term of the acids and alcohols from which they are formed. Esters are water insoluble but generally soluble in organic solvents. The simple aliphatic esters are generally less dense than water. The simple low molecular weight, esters are colourless and low boiling liquids having pleasant odours.

Many esters occur in the fruits, flowers and other parts of plants. Almost all fruits contain numerous esters which contribute to their flavor. Of the 150 components identified in strawberry oil, 42 of them are simple esters.

The high molecular weight aliphatic esters are solid substances having only faint odours, if any. The higher molecular weight esters of monocarboxylic acids and monohydric alcohols or alcohols of the sterol series are known as waxes. An ester having glycerol as the alcoholic substituent
is known as a triglyceride. Fats and fatty oils are composed of mixtures of triglycerides. A variety of high molecular weight esters such as the triglycerides and phospholipids are important biologically active compounds.79-81

PHYSIOLOGICAL ACTIVITY OF THE ESTERS

An important general use for low molecular weight esters such as ethyl acetate and butyl acetate is as solvents for lacquers, paints and varnishes.

Pharmacetically important esters are generally found in aromatic series. On a tonnage basis the esters which are derivatives of salicylic acid are the most important. Aspirin is the most generally used as analgesic in the world today. Methyl salicylate 'oil of wintergreen', is used as flavoring agent in medicinals and in the preparation of muscle liniments.79-81. The esters of p-aminobenzoic acid find extensive use as local and topical anesthetics. Ethyl p-amino benzoate (syn. benzocaine) and N,N-diethyl amino-ethyl-p-amino benzoate (syn. procaine) are well known local anesthetics.

Esters find an economically important use in the preparation of cosmetics, perfumes, soaps and detergents. High molecular weight amino esters are used as low foaming and nonionic detergents. Sucrose esters of fatty acids are used as emulsifiers and biodegradable detergents.

Synthetic low molecular weight simple esters are
used commercially as the base for artificial food flavours for example ethyl formate is used as an artificial essence constituent in peach, raspberry, and rum flavors and ethyl acetate in apple, pear, strawberry and peach.

Each year millions of pounds of high molecular weight esters such as di(2-ethylhexyl)-phthalate are used as plastizers in polymers such as polystyrene and polyvinyl chloride. Other important uses for the high molecular weight esters are as hydraulic fluids, greases and lubricants. Synthetic diesters prepared from $C_6-C_{10}$ dicarboxylic acids and $C_8-C_9$ branched chain alcohols are mostly used. A widely used diester in lubricants is di(2-ethyl hexyl)-sebacate.

Polymerization of methyl methacrylate affords poly (methyl methacrylate) which is a strong thermoplastic solid. It is known as "Lucite" or "Plexiglass" and used in place of glass and for molding transparent objects.

Polyesters have found important uses as fibres, films, laminants and chromatographic stationary phases as well as in urethan-polymer manufacture. These polyesters include poly (ethylene terephthalate) known as 'Dacron', poly (1,4-cyclohexanedimethylene terephthalate) known as "Kodel" and poly (bisphenol A carbonate) known as "Lexan".$^{79-81}$
NATURE OF THE COMPOUNDS ISOLATED BY THE AUTHOR

The author has been able to isolate and characterise the following compounds from two selected Indian Medicinal Plants. A brief idea is mentioned herein.

1. **Limonia crenulata**: The whole plant of *L. crenulata* yielded four compounds. Among them, two are new compounds which have been reported for the first time in nature. The isolated compounds belong to the following chemical groups.

   (i) Sterol : A known sterol.
   (ii) Terpene : A known terpene.
   (iii) Anthraquinoid : A new anthraquinone in the form of glycoside.
   (iv) Coumarin : A new coumarin glycoside.

2. **Aegle marmelos**: Two different parts of *A. marmelos* (mentioned below) yielded five known compounds and two new compounds belonging to the following chemical groups:

   **I. HEART WOOD**

   (i) Sterol : A known sterol.
   (ii) Terpene : A known terpene.
   (iii) Aromatic ester : A new acetate
   (iv) Coumarin : A new coumarin glucoside

   **II. STEM BARK**

   (i) Sterol : A known sterol.
   (ii) Terpene : A known terpene
   (iii) Coumarin : Two known coumarins

In addition to this the extract of *L. crenulata* and the new anthraquinone glycoside exhibited anti-inflammatory activity and the new acetate isolated from heart wood of *A. marmelos* showed analgesic activity which are discussed in Chapter - V.