The development of new reaction pathways in the synthetic organic chemistry by oxidation methods have been very much useful for the organic chemists. Susceptibility of alkenes and hydroxy group to the electrophilic attack and their capability to reduce most of the oxidants motivated the chemists to study the oxidizing effects of transition metal ions and oxides on alkenes and hydroxy group. The importance of metal ion as oxidants is due to their low cost, stability and considerably selectivity with respect to functional groups by virtue of their action.

The most commonly used inorganic oxidants are Potassium permanganate, Osmium tetraoxide, Ruthenium tetraoxide, Palladium chloride, Potassium peroxydisulfate and certain chromium and mercury salts. The silver chromate in presence of iodine was also used to oxidise the steroidal olefins. Besides these, some organic complexes of these metals were also used for the oxidation purpose for example pyridinium chlorochromate, pyridinium dichromate, Butyl chromate etc.

The oxidation of alcohols mainly furnished the carbonyl compounds. The aldehydes and ketones were obtained as the oxidation products from the primary and secondary alcohols respectively. While alkenes afforded either exhaustive oxidation or allylic oxidation products
depending upon the reaction conditions, reagents used and also upon the nature of oxidants. In some cases the reactions were carried out at low temperatures and also at room temperature but in most of the cases the reaction took place at the elevated temperature. The reactions were carried out at low temperatures so as to avoid the extensive oxidation. The products isolated from these oxidations from olefins were ketones, ketols and other degraded products.

Windus and Naggatz\(^2\) reported the oxidation of cholesteryl acetate (I) with chromic acid in acetic acid which yielded cholesta-3,5-dien-7-one(II).

\[
\text{AcO} \quad \text{C}_8\text{H}_{17}
\]

(I) (II)
Fieser et al.\textsuperscript{3,4} identified the oxidation product of Windus and Naggatz obtained by chromic acid oxidation from epicholesteryl acetate(III) as 5-acetoxy-5α-cholestan-3,7-dione(IV) and suggested the interamolecular C\textsubscript{3}-C\textsubscript{5} acyl migration.

The formation of α,β-unsaturated ketones had also been reported from the oxidation of steroidal alkenes with chromic acid. Marshall et al.\textsuperscript{5} reported the introduction of ketone(VI) at C-7 of pregnolone acetate(V) using sodium chromate in acetic acid-acetic anhydride solution. \textsuperscript{8-14} Cholesteryl acetate(VII) with chromium trioxide and acetic acid yielded five products\textsuperscript{6}(VIII-XII). Cholesteryl acetate(I) with chromic acid gave 5,6-seco products\textsuperscript{7}(XIII).
Corey and Suggs\textsuperscript{8} studied the use of pyridinium chlorochromate as oxidant. They reported the advantage of this reagent over others and showed that it could be prepared easily, safely with high capability to convert primary alcohols into aldehydes in better yield. Chromium trioxide when treated with hydrochloric acid gave chlorochromic acid which on reaction with pyridine furnished Pyridium chlorochromate.

\[
\text{CrO}_3 + \text{HCl} \rightleftharpoons \text{HCrO}_3\text{Cl} \xrightarrow{\text{C}_5\text{H}_5\text{N}} \left[\text{CrO}_3\text{Cl}\right]^+ + \text{C}_5\text{H}_5\text{N}^+ \xrightarrow{\text{H}} \text{R} - \text{CH} - \text{R}' + \text{C}_5\text{H}_5\text{N}^+ \left[\text{CrO}_3\text{Cl}\right]^+ \xrightarrow{\text{H}} \text{R} - \text{C} - \text{R}'
\]

William and Co-workers\textsuperscript{9} reported the oxidation of olefins (I, XIV-XXVI) with chromium trioxide-pyridine complex at room temperature and obtained the following products (XXVII-XLV) in good to moderate yield.

\begin{center}
\textbf{Olefins} \hspace{2cm} \textbf{Ketones}
\end{center}

\begin{center}
\begin{tabular}{cc}
\text{OAc} & \text{AcO} \\
\text{(XIV)} & \text{(XXVII)}
\end{tabular}
\end{center}
Wender et al.\textsuperscript{10} reported the oxidation of 1,4-diene (XLVI) by pyridinium chlorochromate and obtained dienones (XLVII) and (XLVIII). Marshall and Wuts\textsuperscript{11} reported the analogous behaviour of 1,4-diene (XLIX) with pyridinium chlorochromate which yielded two products (L and LI).
Djerassi and Lenk\textsuperscript{12} reported the use of N-iodosuccinimide for the synthesis of iodoketones. They treated steroidal enol acetate (LII) with N-iodosuccinimide and obtained 21-ido-pregnenolone acetate (LIII). Muller and Jones\textsuperscript{13} prepared iodoketone (LV) from the enol acetate (LIV):
Siemann et al.\textsuperscript{14} reported the preparation of 3\(\beta\)-substituted (20S)-20-[(benzene sulfonyl)methyl]-pregn-5-en-7-one (LVII) from respective 3\(\beta\)-substituted (20S)-20-[(benzene sulfonyl)methyl]-pregn-5-ene (LVI).

![Chemical structures of LVII and LVI](image)

Cholesterol (LVIII) ubiquitously present in the mammalian tissues is subjected to autoxidation by air, peroxidation \textit{in vivo} and metabolism. These intriguing events and biologically active oxysterols (LIX-LXXIV) thus produced were reviewed in detail\textsuperscript{15-17}. 
The oxidation of cholesterol (LVIII) by Ag CrO$_4$ and I$_2$ furnished the ketone (LXXV)$^{18}$.

The ketones were brominated ordinarily in the presence of added or generated hydrogen bromide resulting thereby, the formation of thermodynamically more stable products. In case of kinetically controlled bromination, the reaction might be effected by carrying out in the presence of an agent capable of removing hydrogen bromide as it was formed eg. sodium acetate or epichlorohydrin. The kinetic product was expected to be same$^{19}$ as the thermodynamic one or different$^{20-22}$ from it depending on steric factors.

Bromination of methylene and methyl ketones in the presence of base could not be stopped at the monobromoketone stage. The polybromoketones, thus, formed were
cleared under the basic conditions to form haloform and carboxylic acid.

The study of α-bromocyclanones was advantageous for two causes, first these compounds containing two strong dipoles, in close proximity, were having the mutual repulsion to the greatest extent when steric strains were at a minimum and second, the approximate relative orientations of the two dipoles could be determined with the help of infrared spectroscopy. It was Corey who advanced the theoretical arguments led to the conclusion that α-bromocyclohexanone should exist almost completely at room temperature occupying the axial position.

It was observed, with the help of infrared spectroscopy that in methylated-2-bromocyclohexanones, the orientation of bromine in the stable conformation was sometimes axial and sometimes equatorial. Hence, in case of 2-bromo-3,3-dimethyl cyclohexanone the more stable conformation was (LXXVI-a, axial) and in the 4,4-dimethyl isomer, it was (LXXVII-e, equatorial). In (LXXVI-e), the electric repulsion between C=0 and C-Br dipoles destabilised it to the extent of some 2.7 K. cal/mole, while steric interactions 1:3 H:Br in (LXXVI-a) was found to destabilise it by only about 0.4 K. cal/mole. So, (LXXVI-a) predominated over (LXXVI-e).
In case of the 2-bromo-4,4-dimethyl cyclohexanone, however, steric repulsion between axial bromine and axial methyl in (LXXVII-a) outweighed the electrical effect in (LXXVII-e) and Br-equatorial was more stable. In case of steroidal bromoketones, these had achieved the conformation of maximum stability since the ring could not flip from one chair form to other. Although, a few bromoketones were known both in liable and stable forms, usually recognisable from the observation that under catalysed by HBr, the
former could be isomerised to the later and the equilibrium was achieved by the enol forms.

Corey\textsuperscript{24} characterised the bromination of steroidal ketones via the corresponding enols in several cases and perhaps, generally by an effect which directed the incoming bromine substituent to the axial rather than the equatorial position. This was an indication that the axial epimer was formed faster rather than the equatorial one, opposing this effect was the classical steric effect which directed a large substituent such as (Br) to the less crowded equatorial orientation. The net result of these two effects which influenced the relative rates of formation of the epimers with axial and equatorial bromine was clear in those cases where the bromo ketone which was isolated as the unstable epimers formed for kinetic rather than for steady state reasons. In such instances the importance of the non-steric effect was apparent since the major product had invariably been found to be the epimer with axial bromine.

Corey\textsuperscript{23} had also developed a rule for predicting the orientation of bromine in all \(\alpha\)-bromoketosteroids with ketones function in ring A, B or C and A/B cis or trans. One method was applied to the stereochemistry of thermodynamically controlled bromination products and the other
method to α-bromoketo steroids whose stereochemistry was kinetically controlled. In every case there was agreement between predicted and determined configuration at C(Br). In a number of cases, it had been reported that the redetermination had been led by the prediction (and eventually reassignment of configuration). It had been shown, with exception, that the bromination of 5α,6β-dibromocholastan-3-one (LXXVII) produced the 4α-derivative (LXXIX) faster than the 4β-derivative (LXXX) although the later was more stable. Similarly, 3α-acetoxy-5α-cholestan-6-one (LXXXI) afforded as predicted, the 5α-bromo derivative (LXXXII), which is isomerised to the 7α-bromo derivative (LXXXIII) by HBr.
Corey generalized the prediction for the stereochemistry to the kinetically controlled brominated products and the prediction was as "the epimer which formed faster in the bromination of keto steroids was that in which bromine was axial".

Sigg et al. carried out the bromination of 5α-cholestan-1-one (LXXXIV) with bromine in acetic acid in the presence of HBr (as catalyst) at room temperature and obtained three compounds, viz. 2β-bromo (LXXXV), 2α,2β-dibromo (LXXXVI) and 2α-bromo (LXXXVII) ketones.
3\(\alpha\)-Bromo-5\(\alpha\)-cholestan-2-one (LXXXIX) was obtained from 5\(\alpha\)-cholestan-2-one (LXXXVIII) by the treatment of bromine in acetic acid containing a trace of HBr.

5\(\alpha\)-Cholesterol-3-one (XC) yielded different compounds under different conditions of bromination. When (XC) was treated with Br\(_2\)/HBr in acetic acid for 10 minutes at room temperature, the product obtained was 2\(\alpha\)-bromo-5\(\alpha\)-cholestan-3-one (XCII)\(^{26,27}\). Dibromination of the (XC) with bromine in acetic acid produced 2\(\alpha\),2\(\beta\)-dibromo-5\(\alpha\)-cholestan-3-one (XCII)\(^{28}\). When bromination of the same compound (XC) was
carried under similar conditions, bromine and acetic acid at room temperature for 20 hours, yielded $2\alpha, 4\alpha$-dibromocholestan-3-one (XClI)\textsuperscript{29}.

Butenandt et al.\textsuperscript{26} also reported the bromination of $5\beta$-cholestan-3-one (XClIV) by Br\textsubscript{2}/HBr in acetic acid at room temperature. The product isolated was characterised as $4\beta$-bromo-$5\beta$-cholestan-3-one (XCV).
Bromination of (XCIV) was studied in detail by Shoppee and Co-workers. Kinetically controlled monobromination of (XCIV) failed to yield the axial 4α-bromoketone (XCVI) and gave equatorial 4β-bromo ketone (XCV). Dibromination of (XCIV) furnished diequatorial 2β, 4β-dibromoketone (XCVII). Acid catalysed monobromination of (XCV) also afforded the 2β, 4β-dibromoketone (XCVII).

Bromination of the 6-ketone (XCVIII) yielded two products (XCIX) major and (C) minor. The configuration of bromine in (XCIX) and (C) was determined with the help of IR and CD spectra which indicated half chair conformation for B ring in these compounds.
Bromination of \(3\beta\)-acetoxy-5\(\alpha\)-cholestan-6-one (CI) was carried out under different reaction conditions\(^{24,33,34}\). A variety of compounds were obtained by these reactions (CII-CV).
When (CI) was treated with Br₂/HBr in ether:acetic acid, it invariably afforded 3β-acetoxy-5,7,7-tribromo-5α-cholestan-6-one (CVI).³⁵

\[ \text{AcO} \quad \text{Br} \quad \text{Br} \]  
\[ \text{AcO} \quad \text{Br} \quad \text{O} \quad \text{Br} \]

(CI) (CVI)

It had been reported³⁶ that the bromination of 3β-chloro-5α-cholestan-6-one (CVII) under different reaction conditions, gave 3β-chloro-5-bromo-5α-cholestan-6-one (CVIII) and the dibromocompound (CIX).
Ellis\textsuperscript{37} carried out bromination of steroidal ketones having an isolated double bond without any effect upon the double bond. $\beta\beta$-Hydroxyandrost-5-en-17-one (CX) gave $\beta\beta$-hydroxy-16\alpha-bromoandrost-5-en-17-one (CXI) on reaction with cupric bromide.

\[ \text{(CX)} \quad \text{(CXI)} \]

Kirk et al.\textsuperscript{38} reported the bromination of cholest-4-en-3-one (LXVIII) in presence of proton acceptor (collidine) and 4-bromocholest-4-en-3-one (CXII) was obtained. Though, it was previously observed that 3-oxo-$\Delta^4$-steroids on bromination with bromine in acetic acid or with N-bromosuccinimide in a suitable solvent, generally afforded the allylic bromo product with the corresponding 6-bromo and 2,6-dibromo-3-oxo-$\Delta^4$-steroids\textsuperscript{39}. 
Djerassi and Co-workers\textsuperscript{39} dibrominated-$\Delta^4$-androstene-3,17-dione (CXIII) with bromine and HBr in acetic acid and got the dibromocompound (CXIV).

When androst-4-en-3,17-dione (CXIII) was treated with equimolar quantity of N-bromosuccinimide in carbon tetrachloride simply allylic bromination was noticed and
2.27

6-bromo-Δ⁴-androsten-3,17-dione (CXV) was obtained. 2α-Bromocholest-4-en-3-one (CXVI) on bromination with N-bromosuccinimide afforded 2α,6β-dibromocholest-4-en-3-one (CXVII).

\[
\text{(CXIII)} \quad \text{(CXV)}
\]

Bromination of cholest-5-en-4-one (CXX) afforded 5, 6β-dibromo-5α-cholestan-4-one (CXXI).

\[
\text{(CXVI)} \quad \text{(CXVI)}
\]

5α-Cholest-2-en-4-one (CXVII) in chloroform was treated with bromine at 20°C providing 2β, 3α-dibromo-5α-cholestan-4-one (CXIX), the diaxial addition product. Bromination of cholest-5-en-4-one (CXX) afforded 5, 6β-dibromo-5α-cholestan-4-one (CXXI).
Reaction of 3\(\beta\)-acetoxy-5,16-dien-20-one (CXXII)\(^{37}\) with cupric bromide in tetrahydrofuran was carried out with the thought of producing results analogous to those obtained by Sollman and Dodson\(^{41}\) i.e. bromine should be introduced at C\(_{15}\) to yield (CXXIII) but the product obtained was 21-bromoderivative (CXXIV).
The five membered doubly unsaturated heterocyclic system containing one nitrogen and one sulfur atom was called thiazole but there were two possibilities for the arrangement of sulfur and nitrogen atoms in the ring: (A) nitrogen and sulfur atoms were at 1,2-positions with the three carbon atoms, such an arrangement was known as isothiazole (CXXV), (B) Nitrogen and sulfur atoms were
arranged at 1,3-positions and called as thiazole (CXXVI).

![Thiazole molecules](image)

(CXXV)  (CXXVI)

The dihydrothiazoles or thiazolines (CXXVII) and (CXXVIII) and tetrahydrothiazole or thiazolidine (CXXIX), constituting a well known and important class of compounds, were also from the same group i.e. thiazole. Besides these, many polycyclic and fused ring systems containing the thiazole nucleus were also known.

![Thiazole derivatives](image)

(CXXVII)  (CXXVIII)  (CXXIX)

The history of true thiazole series began in 1879 with the work of Hoffmann who prepared derivatives of benzothiazole, such 2-chlorobenzothiazole and 2-phenyl benzothiazole. Compounds containing the simple thiazole nucleus were reported by Hantzch and Co-workers.
After this work, knowledge of the thiazole system developed steadily and many discoveries of commercial and biological interest gave impetus to the study. Primuline base, a yellow substance and dihydrothio-p-toluidine were obtained by the fusion of p-toluidine with sulfur. These substances were immediately recognised as benzothiazole derivatives. Williams et al. demonstrated the existence of the simple thiazole ring in vitamin B (Thiamine).

During the last few years, a large number of steroidal thiazoles had been synthesised by different routes, when a mixture of o-toluidine hydrochloride and 2α-thiocyanato-17α-methyl-androstan-3-en-17β-ol (CXXX) in ethanol was refluxed with ethyl acetate provided 17α-methyl-17β-hydroxy-androsteno-(3,2-d)-2',3'-disubstituted thiazolines (CXXXI-CXXXIII).
When 3β-acetoxy-5α-androstan-16α-bromo-17-one (CXXXIV) was treated with thiourea, provided 3β-acetoxy-5α-androsteno[17,16-d] 2′-amino thiazole (CXXXV).
Similar treatment of $\text{17}\beta\text{-acetoxy-2}\alpha\text{-bromo-5}\alpha\text{-androstan-3\text{-one (CXXXVI)}}$ provided $\text{17}\beta\text{-acetoxy-5}\alpha\text{-androsteno [3,2-d] 2'\text{-aminothiazole (CXXXVII)}}$ and $\text{5}\alpha\text{-cholesteno (3,2-d) 2'\text{-aminothiazole (CXXXIX)}}$ was obtained from its corresponding bromoketone (CXXXVIII).
The oxazole ring is almost similar to that of thiazole. The only difference in the two is that in thiazole ring there is sulfur-atom while in oxazole, the oxygen atom is present in place of sulfur atom. So, the oxazoles may be defined as doubly unsaturated five membered heterocyclic ring containing one oxygen atom and one nitrogen atom at 1,3-positions as hetero-atoms.

The development of oxazole chemistry had a restricted path due to a paucity of synthetic methods. No substance had been found to occur naturally with the oxazole nucleus. So, this might be the reason for the development.

The joint Anglo-American effort to synthesise pencillin led to considerable progress. Although the pencillin, a fascinating molecule does not contain the oxazole moiety but many oxazole derivatives were synthesized in the course of this work, some of them being possible intermediate for the synthesis of antibiotic.

The oxazoles and their derivatives had been reported to possess biological activities such as anti-inflammatory, analgesic, antibacterial, antiviral and hypertensive. The oxazole derivatives had also been reported to possess many applications of industrial importance such as whitening agents, efficient high
temperature antioxidants, lubricants, tablet coatings, textile, cigarette filters, additives, rust inhibitors, components of photographic emulsions etc. Many routes had been developed for the synthesis of oxazoles viz from 1,3-polar cycloaddition, from α-azidoketone, from α-halo-ketones etc. Some of them were discussed below:

17β-Acetoxy-5α-androstan-3-one (CXL) on treatment with lead tetra acetate and BF₃-Et₂O provided 2α,17β-diacetoxy-5α-androstan-3-one (CXL1) which on Davidson's reaction⁵² afforded the oxazole (CXLII) using ammonium acetate and acetic acid.

![Chemical Structure](image)

On similar treatment, 4β,17β-diacetoxy-5α-hydroxyandrostan-3-one (CXLIII) gave the corresponding oxazole,
(CXLIV) and 4β-acetoxy-5α-hydroxycholestan-3-one (CXLV) provided cholest-5-dieno (3,4-d) 2'-methyl oxazole (CXLVI).

2α-Acetoxy or 2α-bromo-3-ketones of androstane and cholestane series were converted into 2'-methyl steroidal (3,2-d)-oxazoles (CLIII-CLV) by the reaction of ammonium acetate.⁵³
\[ R = \text{OAc or Br} \]
Reductive acylation of (CLVI-CLVIII) provided the 2α-acetamido-3-ketones (CLIX-CLXI) which were cyclised by sulfuric acid to afford 2'-methyl steroidal (2,3-d)-oxazoles (CLXII-CLXIV)\textsuperscript{53}.

![Chemical structures of CLVI-CLXIII](attachment:image.png)
(Azidoketone (CLXV) and (CLVI), prepared from 2α-bromocholstan-3-one and 7α-bromocholstan respectively, showed cycloaddition reaction with acyl halide in the presence of triphenyl phosphine to give oxazolosteroids (CLVII) and (CLVIII).
The steroidal 6-oximes (CLIX) and (CLX), of cholestane series, were treated with acetyl chloride and HCl gas in presence of pyridine and acetic anhydride to afford the respective oxazoles, (CLXI) and (CLXII).
The thiazoles and oxazoles had been reported to show remarkable biological activities such as anti-inflammatory, antihistaminic, antimicrobial, antitumor etc. These activities prompted us to carry out the synthesis of steroidal thiazoles and oxazoles in continuation to our previous work.

In this chapter, the synthesis of 3$\beta$-acetoxy 2'-amino-5$\alpha$-cholest-6-eno(6,7-d) thiazole (CLXIII) from 3$\beta$-acetoxy-$\alpha$-bromo-5$\alpha$-cholestan-6-one (CIII), 2'-amino-5-methoxy-5$\alpha$-cholest-3-eno(3,4-d) thiazole (CLXV) from 4$\beta$-bromo-5-methoxy-5$\alpha$-cholestan-3-one (CLXIV) (which was obtained from cholest-4-en-3-one (LXVIII)), 2'2''-diaminocholest-4-en-2,6-dieno (3,2-d and 6,7-d)dithiazole (CLXVIII) from 2$\alpha$,7$\alpha$-dibromocholest-4-en-3,6-dione (CLXVII) as intermediate obtained from cholest-4-en-3,6-dione (LXXIII), 2'-amino-5-methoxy-5$\alpha$-cholest-3-eno (3,4-d)oxazole (CLXVI) from bromo ketone (CLXIV) and 2'-amino-2$\alpha$-bromocholest-4-en-6-eno(6,7-d)oxazole (CLXIX) had been reported. The scheme of the synthesis of these compounds has been given on the next page.
Scheme of Synthesis

1. Br₂ - AcOH
2. CrO₃ - H⁺
3. Zn - AcOH
4. Oxalic acid
5. NBS - MeOH

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Reaction of 3β-acetoxy-7α-bromo-5α-cholestan-6-one (CIII) with thiourea:

To a solution of 3β-acetoxy-7α-bromo-5α-cholestan-6-one (CIII) in ethanol and p-toluene sulfonic acid (catalytic amount), thiourea was added and the contents were heated on a water bath for 8 hours. After heating, the reaction mixture was diluted with water and extracted with ether. The ethereal layer was washed with water and dried over anhydrous sodium sulfate. The crystallisation of the oil provided a compound having m.p. 202°C.
Characterisation of the compound, m.p. 202°C, as 3β-acetoxy-5α-cholest-6-eno(6,7-d)thiazole (CLXIII):

The compound having m.p. 202°C was correctly analysed for C_{30}H_{48}N_{2}O_{2}S. The IR spectrum of the compound showed weak absorption bands at 3450, 3300, 3150 cm\(^{-1}\) and strong absorption bands at 1730 and 1265 cm\(^{-1}\) which were due to the presence of \(-\text{NH}_2\) and \(\text{CH}_3\text{COO}\)-groups respectively. These values indicated the presence of thiazolyl moiety\(^{56}\). The \(^1\)H-NMR spectrum of the compound displayed a broad singlet at \(\delta\) 5.3 integrating for two protons exchangeable with deuterium could be assigned to \(-\text{NH}_2\) and another broad multiplet integrating for one proton centred at \(\delta\) 4.71 for C\(^5\) \(\alpha\)H (\(\nu\) = 18 Hz)\(^{57}\). The signal at \(\delta\) 2.05 integrating for three protons was due to the acetyl methyl. The angular and side chain methyl protons were observed at \(\delta\) 1.2 (C\(_{10}\)-CH\(_3\)), 0.78 (C\(_{13}\)-CH\(_3\)) and 0.91, 0.81. On the basis of these data, the compound having m.p. 202°C was characterised as 3β-acetoxy-2'-amino-5α-cholest-6-eno(6,7-d)thiazole\(^{58}\).

Reaction of cholest-4-en-3-one (LXVIII) with N-bromosuccinimide and methanol in presence of \(\text{H}_2\text{SO}_4\) (as catalyst);

A solution of cholest-4-en-3-one (LXVIII) in ether at 0°C was added absolute methanol, NBS and 2 drops of sulfuric acid. The mixture was stirred and allowed to attain
the room temperature with continuous stirring for 4 hours\(^59\).
After completion of the reaction, the contents were poured onto crushed ice water and extracted with ether. The ethereal layer was washed with sodium bicarbonate solution (10%) and water and dried over anhydrous sodium sulfate. Removal of the solvent and column chromatography provided an oil which on crystallisation gave the crystals having m.p. 152-154°C.

Characterisation of the compound, m.p. 152-154°C, as 4β-bromo-5-methoxy-5α-cholestan-3-one (CLXIV):

The compound was characterised for its molecular formula as C\(_{28}\)H\(_{47}\)O\(_2\) Br on the basis of elemental analysis.
Its IR showed bands at 1695 cm\(^{-1}\) (C=O), 1220, 1165 and 1140 cm\(^{-1}\) for (C-OC) linkage, another band at 765 cm\(^{-1}\) was observed for C-Br. In \(^1\)H-NMR, a singlet integrating for one proton was observed at \(\delta 5.02\) could be assigned to \(C_4-\alpha H\), another singlet for three protons at \(\delta 4.02\) was assigned to methyl protons of methoxy group at \(C_5\). The angular methyl protons were observed at \(\delta 1.38\) (s, 3H, \(C_{10}-CH_3\)) and 0.74 (s, 3H, \(C_{13}-CH_3\)). The side chain methyl protons were observed at \(\delta 0.78, 0.81\) and 0.91. The down field value of \(C_4\)-proton suggested that the proton present should be equatorial. The reaction conditions used indicated that the bromine should occupy the \(\alpha\)-position with respect to carbonyl group. So, on the basis of above discussion, the structure of the compound was concluded as \(4\beta\)-bromo-5-methoxy-5\(\alpha\)-cholestan-3-one (CLXIV).

**Reaction of \(4\beta\)-bromo-5-methoxy-5\(\alpha\)-cholestan-3-one (CLXIV) with thiourea:**

A solution of \(4\beta\)-bromo-5-methoxy-5\(\alpha\)-cholestan-3-one (CLXIV) in ethanol was treated with thiourea in presence of p-toluene sulfonic acid (as catalyst). After completion of the reaction, the contents were worked up in usual manner and crystallised to provide the compound with m.p. 168°C.
Characterisation of the compound, m.p. 168°C, as 2'-amino-5-methoxy-5α-cholest-3-eno(3,4-d)thiazole (CLXV):

The compound, m.p. 168°C, was analysed for C_{29}H_{48}O_{12}N_{2}S. Its IR showed bands at 3300 cm\(^{-1}\) for (\(-NH_{2}\)), 1620 for (C=C) 1525 cm\(^{-1}\) for (C=N), 1370 (C-N) and 690 cm\(^{-1}\) for (C-S). The \(^{1}\)H-NMR of the compound gave a broad singlet at \(\delta\) 4.95 integrating for two protons disappeared on shaking with D\(_2\)O, was assigned for \(-NH_{2}\) protons. Another sharp singlet appeared at \(\delta\) 3.91 integrating for three protons was for methyl protons of methoxy group at C\(_{5}\). The angular methyl protons appeared as usual at \(\delta\) 1.26 (\(C_{10}-CH_{3}\)) and 0.76 (\(C_{13}-CH_{3}\)). The other side chain methyl protons were observed at \(\delta\) 0.94, 0.84 and 0.81. So, the structure was concluded as 2'-amino-5-methoxy-5α-cholest-3-eno(3,4-d) thiazole on the basis of above discussion.
Reaction of 4β-bromo-5-methoxy-5α-cholestan-3-one (CLXIV) with urea:

4β-Bromo-5-methoxy-5α-cholestan-3-one (CLXIV) was treated with urea in the similar fashion as it was treated with thiourea providing a crystallisable compound with m.p. 92-93°C.

Characterisation of the compound, m.p. 92-93°C, as 2'-amino-5-methoxy-5α-cholest-3-eno(3,4-d)oxazole (CLXVI):

The compound analysed for C_{29}H_{48}O_{2}N_{2} showed bands at 3280 cm\(^{-1}\) for (-NH\(_2\) group), 1620 cm\(^{-1}\) for (C=C), 1570 (C=N), 1355 (C-N), 1265 and 1060 cm\(^{-1}\) (for C-O) in its IR spectrum. The \(^1\)H-NMR showed broad singlet at δ 5.1
intergrating for two protons disappeared on D₂O shake were assigned for NH₂ protons. A singlet at δ 4.2 for three protons was for OCH₃. The values at δ 1.31 and 0.76 were given for angular methyl groups at C₁₀ and C₁₃ while side chain methyl protons were given the values δ 0.78, 0.84 and 0.92. So, on the basis of above discussion, the structure for the compound with m.p. 92-93°C was assigned as 2'-amino-5-methoxy-5(4)-cholest-3-eno(3,4-d)oxazole (CLXVI).

Reaction of cholesterol (LVIII) with Pyridinium dichromate (PDC):

A well stirred solution of cholesterol in N,N-dimethyl formamide, PDC was added at room temperature and contents were continuously stirred for 4 hours. After completion of the reaction, the contents were poured onto water and organic matter was extracted with ether. The ethereal layer was washed with water, dil. HCl and water and dried over anhydrous sodium sulfate and the removal of the solvent gave a crystallisable compound with m.p. 124°C.
Characterisation of the compound, m.p. 124°C as cholest-4-en-3,6-dione (LXXIII):

The compound, m.p. 124°C, analysed for \( \text{C}_{27}\text{H}_{42}\text{O}_2 \) gave \( \lambda_{\text{max}} \) at 250.8 nm in its U.V. spectrum. The IR spectrum showed strong band at 1695 cm\(^{-1}\) for (C=O) group. Another band at 1605 cm\(^{-1}\) was observed for (C=C). The \(^1\text{H}-\text{NMR}\) gave a strong peak at \( \delta 6.15 \) as singlet integrating for one proton easily assigned for vinylic \( C_4^-\text{H}^- \). A double doublet integrating for one proton appeared at \( \delta 2.66 \) could be assigned to \( C_7^-\text{equatorial} \) proton with 5 Hz and 19 Hz as the coupling constants. The 5 Hz value was for axial and equatorial coupling while 19 Hz was for the gem coupling. The down field nature of the peak for one proton at \( C_7^- \) was due to deshielding effect of carbonyl group while the another proton at \( C_7^\circ \) appeared at \( \delta 2.02 \) again as double doublet with coupling constants 19 Hz and 5 Hz for gem and pseudoaxial axial couplings. A multiplet at \( \delta 2.49 \) integrating for two protons was assigned to \( C_2^-\)protons. Another multiplet integrating for two protons centred at \( \delta 2.12 \) was assigned to \( C_1^-\)protons. In \(^{13}\text{C}-\text{NMR}\), peaks at \( \delta 161.652 \) and 125.404 were assigned to \( C_5^- \) and \( C_4^- \) carbon atoms respectively. The \( \delta 46.7842 \) was assigned to \( C_7^- \) atom on the basis of 2d-\( \text{NMR} \) spectrum. The signal of \( C_7^- \) atom splitted into two coinciding with the two protons of \( C_7^- \) appearing at the different values in its \(^1\text{H}-\text{NMR}\). The \( C_2^- \) atom appeared at
 δ 39.4332 while C₁-at δ 39.1128. Its molecular ion peak in mass spectrum was at 398 for 100% abundance. The other important fragment ion peaks were discussed in the scheme-1. So on the basis of these findings, the compound was characterised as cholest-4-en-3,6-dione.

Reaction of cholest-4-en-3,6-dione(LXXIII) with N-bromosuccinimide:

N-Bromosuccinimide was added in portions in refluxing solution of cholest-4-en-3,6-dione in dry benzene in presence of benzoyl peroxide as catalyst. After completion of the reaction, the solvent was evaporated under reduced pressure and residue obtained was worked up with ether and column chromatographed over silica gel affording a crystallisable solid with m.p. 180°C.
Scheme - I

\( m/z \, 380 \)

\(-\text{H}_2\text{O}\)

\( m/z \, 285 \)

\(-\text{C}_8\text{H}_{17}\)

\( m/z \, 270 \)

\(-\text{CH}_3\)

\( (LXXIII) \)

\( m/z \, 383 \)

\(-\text{C}_8\text{H}_{17}\)

\(-\text{CO}\)

\( m/z \, 242 \)

\( m/z \, 370 \)

\(-\text{C}_{17}\text{H}_{28}\text{O}_2\)

\( m/z \, 137 \)

\(-\text{CH}_3\)

\(-\text{C}_{19}\text{H}_{33}\)

\( M+398 \)

\(-\text{CO}\)

\( m/z \, 134 \)

\( m/z \, 270 \)
Characterisation of the compound, m.p. 180°C, as 2\(\alpha\), 7\(\alpha\)-dibromocholest-4-en-3,6-dione (CLXVII):

The compound, m.p. 180°C analysed for \(\text{C}_{27}\text{H}_{40}\text{O}_{2}\text{Br}_{2}\) gave \(\lambda_{\text{max}}\) at 240.8 in U.V. spectrum. Its IR spectrum gave absorption bands at 1700, 1605 and 785 cm\(^{-1}\) for \(\text{C} = \text{O}\), \(-\text{C} = \text{C}\) and \(-\text{C} - \text{Br}\) respectively. The \(^1\text{H}-\text{NMR}\) of the compound revealed a singlet integrating for one proton, at \(\delta 6.32\), assigned to \(\text{C}_4\)-vinyllic proton. A double doublet at \(\delta 4.85\) with coupling constants 5.0 Hz and 14 Hz was characterised to \(\text{C}_2\)-proton (axial) and therefore \(\text{C}_2\) bromine was equatorial (pseudo). The \(\text{C}_7\)-proton with J value 3 Hz appeared as doublet at \(\delta 4.38\) suggested its equatorial nature and bromine as axial. The equatorial proton of \(\text{C}_1\) with coupling constants 5 Hz and 14 Hz appeared at \(\delta 2.7\) as double doublet. The axial proton of \(\text{C}_1\) appeared at \(\delta 2.46\) as a triplet with J value 14 Hz. The two different values for the two different protons at \(\text{C}_1\) were assigned with the help of 2d-NMR.

The \(^{13}\text{C}-\text{NMR}\) gave the distinguished peaks at \(\delta 193.994\) for \(\text{C}_6=\text{O}\), 190.377 for \(\text{C}_3=\text{O}\), 159.3126 for \(\text{C}_5\) and \(\delta 126.544\) for \(\text{C}_4\). Some other values for the carbon atoms were assigned at \(\delta 57.6270\) for \(\text{C}_7\), 51.8922 for \(\text{C}_{14}\), 49.1342 for \(\text{C}_2\), 47.4651 for \(\text{C}_1\), 43.2928 for \(\text{C}_8\), 37.6693 for \(\text{C}_9\). The values for the quarternary carbons i.e. \(\text{C}_{13}\) and \(\text{C}_{10}\) were assigned as \(\delta 43.4298\) and 42.2525 respectively. The methyl carbons were assigned as \(\delta 12.2957, 18.6197, 18.3919,\)
22.8054 and 22.5396 for C_{18}', C_{19}', C_{21}', C_{26} and C_{27} respectively. These values were assigned with the help of distortionless enhancement by polarization transfer (DEPT) and correlation spectroscopy. The mass spectrometry provided strong support for two Br-atoms in the molecule because it gave the molecular ions M^+: 554, M+2:556 and M+4:558 in 1:2:1 ratio. Some of the important peaks could be rationalised in the scheme-2.

Besides this the X-ray studies also supported the structure of the compound as 2α,7α-dibromocholest-4-en-3,6-dione (CLXVII).

Reaction of 2α, 7α-dibromocholest-4-en-3,6-dione (CLXVII) with thiourea:

A solution of 2α,7α-dibromocholest-4-en-3,6-dione and thiourea in alcohol was heated under reflux in presence of p-toluene sulfonylic acid. After completion of the reaction, the solvent was evaporated under reduced pressure and the residue was taken in ether. The ethereal layer was washed with water, sodium bicarbonate solution (5%) and water. The ethereal solution containing compound was dried over anhydrous sodium sulfate. Removal of the solvent provided a brown solid which was crystallised from methanol to provide a compound with m.p. 207°C.
**X-RAY STRUCTURE**

**Scheme - 2**

\[(\text{CLXVII})\]

\[
\begin{align*}
\text{M}^+ & = 554; \text{M}+2 = 556; \text{M}+4 = 558 \\
\text{m/z} & = 395 \\
\text{m/z} & = 252 \\
\text{m/z} & = 282 \\
\text{m/z} & = 224 \\
\text{m/z} & = 17 \\
\text{m/z} & = 254
\end{align*}
\]
Characterisation of the compound, m.p. 207°C, as 2',2''-diaminocholest-4-en-2,6-dieno(3,2-d and 6,7-d)dithiazole (CLXVIII):

The compound having m.p. 207°C was analysed for $C_{29}H_{44}N_4S_2$. In its IR spectrum a broad absorption band at 3260 cm$^{-1}$ was observed which was due to the presence of amino groups (-NH$_2$) and a band at 1625 cm$^{-1}$ for (C=C). For -C=N, a band at 1545 cm$^{-1}$ was observed while a band at 1370 cm$^{-1}$ was also observed for C-N. The (C-S) absorption band was observed at 670 cm$^{-1}$. The $^1$H-NMR showed a sharp singlet at $\delta$ 6.47 integrating for one proton was assigned to
C\textsubscript{4}-vinlyc proton. A broad peak integrating for four protons was observed at $\delta$ 5.35, disappearing on D\textsubscript{2}O shake was assigned for the protons of two amino groups attached with the thiazole moieties. The other peaks for angular methyl protons and side chain methyl protons were observed at 1.18 (C\textsubscript{10}-CH\textsubscript{3}), 0.78 (C\textsubscript{13}-CH\textsubscript{3}), 1.02, 0.88 and 0.84 (for side chain methyl protons). So, on the basis of these studies, the compound having m.p. 207°C was characterised as 2\textsuperscript{',}2\textsuperscript{''}-diaminocholest-4-en-2,6-dieno(3,2-d' and 6,7-d) dithiazole (CLXVIII).

**Reaction of 2\textalpha, 7\textalpha-dibromocholest-4-en-3,6-dione (CLXVII) with urea:**

A solution of 2\textalpha,7\textalpha-dibromocholest-4-en-3,6-dione (CLXVII) and urea in ethyl alcohol was heated under reflux. After completion of the reaction, the mixture was worked up in the usual manner affording a non-crystallisable amorphous solid having m.p. 156°C.
Characterisation of the amorphous solid, m.p. 156°C, as 2'-amino-2α-bromocholest-4-en-6-eno(6,7-d)oxazole (CLXIX):

The amorphous solid was analysed for C_{28}H_{43}O_{2}N_{2}Br. The IR spectrum of the compound showed an absorption band at 3250 (-NH₂), 1700 (-C=O) weak absorption band at 1620 cm⁻¹ for C=C, 1550 (C=N), 1330 (C-N), 1270, 1050 (C-O) and 775 cm⁻¹ (C-Br). In its ¹H-NMR, a sharp singlet for one proton at δ 6.44 was observed and it was assigned for C₄-vinylic proton. A double doublet integrating for one proton present at δ 4.82 with coupling constants 6 Hz (Jae) and 14 Hz (Jaa) was observed. The coupling constant values 4 Hz and 14 Hz suggested the β-orientation of C₂-proton. Hence, the orientation of bromine atom at C₂ should be β. A broad singlet integrating for 2-protons was observed at δ 4.48. The broad peak disappeared on D₂O shake. So, the peak was assigned to the protons of -NH₂ of oxazole moiety. Two sharp singlet at δ 1.32 and 0.77 were observed each integrating for 3-protons. These were assigned to the protons of angular methyl groups at C₁₀ and C₁₃ respectively. The side chain methyl protons were appeared at δ 1.02, 0.96 and 0.92. So, on the basis of above discussion the compound was characterised as 2'-amino-2α-bromocholest-4-en-6-eno (6,7-d)oxazole (CLXIX).
**3β-Acetoxycholest-5-ene (I):**

A mixture of cholesterol (LVIII, 50 g), pyridine (75 ml, freshly distilled over KOH) and acetic anhydride (50 ml) was heated on a water bath for 2 hours. The resulting brown solution was poured onto crushed ice-water mixture with stirring. A white solid thus obtained was filtered under suction and washed with water so as to remove pyridine and air dried. The crude product on recrystallisation from acetone gave pure 3β-acetoxycholest-5-ene (I, 48.0 g) m.p. 115°C (reported\(^6\) m.p. 116°C).

**3β-Acetoxy-6-nitrocholest-5-ene (CLXX):**

3β-Acetoxycholest-5-ene (I, 10 g) was covered with nitric acid (200 ml, 1.42 d and 50 ml, 1.52 d) and sodium nitrite (10 g) was gradually added over a period of 1 hour with continuous stirring. Slight cooling was also done during the reaction and the stirring was continued for additional 2 hours. When yellow spongy mass separated out on the surface of the mixture, the mixture was diluted with cold water (250 ml) resulting a green coloured solution. The whole mass was extracted with ether. The ethereal layer was washed with water and sodium bicarbonate solution (5%) and again with water and dried over anhydrous sodium
sulfate. Removal of the solvent provided an oil which was crystallised from methanol to give the nitro compound (CLXX, 7.0 g) m.p. 103°C (reported\textsuperscript{61} m.p. 102-104°C).

\textbf{3β-Acetoxy-5α-cholestan-6-one (CI):}

Nitro compound (CLXX, 6 g) was dissolved in glacial acetic acid (250 ml) and zinc dust (12.0 g) was added in small portions with shaking. The suspension was heated under reflux for 4 hours, water (12 ml) was added during the course of reaction. The hot solution was filtered cooled to room temperature and diluted with the large excess of water. The precipitate thus obtained was taken in ether. The ethereal solution was washed with water, sodium bicarbonate solution (5%) and again with water and dried over anhydrous sodium sulfate. Removal of the solvent gave on oil which on crystallisation from methanol gave the ketone (CI, 3.9 g) m.p. 128°C (reported\textsuperscript{62} m.p. 127-128°C).

\textbf{3β-Acetoxy-7α-bromo-5α-cholestan-6-one (CIII):}

A solution of bromine (2.12 g Br\textsubscript{2} in 25 ml acetic acid) was added dropwise to a solution of 3β-acetoxy-5α-cholestan-6-one (CI, 6.0 g in 75 ml ether and 15 ml acetic acid) and refluxed for 22 hours. After usual work up and evaporation of the solvent gave an oil which was
crystallised from methanol to provide bromoketone (CIII, 5.2 g) m.p. 146°C reported\(^3\) m.p. 145°C).

Reaction of 3β-acetoxy-7α-bromo-5α-cholestan-6-one with thiourea: 3β-Acetoxy-2'-amino-5α-cholest-6-enσ (6,7-d)-thiazole (CLXIII):

3β-Acetoxy-7α-bromo-5α-cholestan-6-one (CIII, 1.25 g) in ethanol (25 ml) was refluxed with thiourea (0.181 g) in presence of p-toluene sulfonic acid for 8 hours. The reaction mixture was diluted with water and extracted with ether and dried over anhydrous sodium sulfate. Removal of the solvent gave an oil which was crystallised from petroleum ether to provide the thiazole (CLXIII, 0.875 g) m.p. 201°C (reported\(^5\) m.p. 202°C).

Analysis found : C, 71.48; H, 9.3; N, 5.5
Required : C, 72.0; H, 9.6; N, 5.6%

IR : \(\nu_{\text{max}}\) 3450, 3300, 3150 (-NH\(_2\))
1730, 1265 (CH\(_3\)COO), 1630 (C=C)
1525 (C=N) 1460, 1375 (C-N) and 665 cm\(^{-1}\) (C-s).

\(^1\)H-NMR : \(\delta\) 5.3 (brs, -NH\(_2\), exchangeable with deuterium), 4.71 (br, m, \(\text{W}_\text{H}=18\text{Hz}\); C\(_3\)-\(\alpha\)H) 2.05 (s, CH\(_3\)COO-), 1.20 (C\(_{10}\)-CH\(_3\)), 0.78 (C\(_{13}\)-CH\(_3\)), 0.91 and 0.81 other methyl protons.
3β-Hydroxy-5,6β-dibromo-5α-cholestane (CLXXI)

To a solution of cholesterol (LVIII, 14g) in ether (100 ml) was added bromine solution (5 ml Br₂ in 100 ml acetic acid containing 2g of anhydrous sodium acetate) gradually with stirring. The solution turned yellow and promptly set to a stiff paste of dibromide. The mixture was cooled and stirred with glass rod for 5 minutes to ensure complete crystallisation. The product was then filtered under suction and washed with cold ether : acetic acid (3:7) mixture until the filterate was completely colourless. The white dibromide was air dried (15 g) m.p. 113°C (reported m.p. 112-113°C).

5,6β-Dibromo-5α-cholestan-3-one (LXXVIII):

3β-Hydroxy-5,6β-dibromo-5α-cholestane (CLXXI, 10g) was suspended in acetone (300 ml) in a three necked flask fitted with a stirrer and a dropping funnel. The suspension was stirred for 5 minutes and Jones's reagent (15 ml) was then added dropwise in a course of 15 minutes. The temperature of the reaction mixture during oxidation was maintained between 0-5°C by external coolings. After complete addition, the stirring was continued for additional 15 minutes and cold water (200 ml) was then added. The product so obtained was filtered under suction and air dried to afford the dibromoketone (LXXVIII, 8.5 g) m.p. 74°C (reported m.p. 73-75°C).
Cholest-5-en-3-one (LXVII):  

5,6β-Dibromo-5α-cholestan-3-one (LXXVIII, 10g) was dissolved in ether (200 ml) and glacial acetic acid (5 ml) was added. Zinc (15 g) was then added in small portions during 30 minutes with constant shaking. After complete addition, the ethereal layer containing suspended zinc dust was filtered, washed with water, sodium bicarbonate solution (5%) and again with water then dried over anhydrous sodium sulfate. Removal of the solvent provided an oil which was crystallised from methanol to give the pure cholest-5-en-3-one (LXVII, 6 g) m.p. 126°C (reported m.p. 125°C).

Cholest-4-en-3-one (LXVIII):  

A solution of cholest-5-en-3-one (LXVII, 6 g) in ethanol (60 ml) containing oxalic acid (0.8 g) was heated under reflux for 15 minutes. The reaction mixture was poured into cold water and extracted with ether. The ethereal solution was washed with water, sodium bicarbonate solution (5%) and water successively and dried over anhydrous sodium sulfate. The oily residue, obtained after evaporation of the solvent, was crystallised from methanol to give cholest-4-en-3-one (LXVIII, 2.4 g) m.p. 80-81°C (reported m.p. 80°C).
Reaction of cholest-4-en-3-one (LXVIII) with N-bromosuccinimide and methanol in presence of sulfuric acid (as catalyst): 4β-Bromo-5-methoxy-5α-cholestan-3-one (CLXIV):

To a well stirred solution of cholest-4-en-3-one (LXVIII, 2g) in dry ether (20 ml) and absolute methanol (2 ml) at 0°C, N-bromosuccinimide (1g) was added in presence of sulfuric acid (2 drops, as catalyst). The resulting solution was stirred for 3 hours with allowing the temperature to rise to room temperature. After completion of the reaction, monitored with the help of TLC, the reaction mixture was poured onto cold water and extracted with ether. The ethereal layer was washed successively with water, sodium bicarbonate solution (5%), sodium sulfite solution (5%, so as to remove the unreacted N-bromosuccinimide) and again with water and dried over anhydrous sodium sulfate. Removal of the solvent provided a mixture which on column chromatography over silica gel with petroleum ether : ether (8 : 1) as the solvent system afforded the compound which on crystallisation from methanol provided the bromoketone (CLXIV, 1.0g) m.p. 152-154°C.

Analysis Found : C, 67.42; H, 9.34
Required : C, 67.88; H, 9.5%
IR : ν max 1695 (C=O), 1220, 1165, 1140(C-O-), 765 cm⁻¹(C-Br)
Reaction of 4\(^\beta\)-bromo-5-methoxy-5\(^\alpha\)-cholestan-3-one (CLXIV) with thiourea: 2'-Amino-5-methoxy-5\(^\alpha\)-cholest-3-eno(3,4-d)thiazole (CLXV):

4\(^\beta\)-Bromo-5-methoxy-5\(^\alpha\)-cholestan-3-one (CLXIV, 0.5g) was taken in alcohol (10 ml). To it, thiourea (0.15g) and p-toluene sulfonic acid (catalytic amount) were added and the contents were heated under reflux for 5 hours. After 5 hours, the reaction mixture was worked in the usual manner. Evaporation of the solvent and crystallisation from acetone provided a solid compound, (CLXV, 0.36g) m.p. 168°C.

Analysis Found : C, 72.91; H, 10.27; N, 5.96
Required : C, 73.04; H, 10.43; N, 6.09%
IR : \nu_{\text{max}} 3300(\text{NH}_2), 1620 (\text{C=C}), 1525 (\text{C=N}), 1370 (\text{C-N}), 690 \text{ cm}^{-1} (\text{C-S})

\(^1\text{H-NMR} : \delta 4.95 (\text{brs, } 2\text{H, } -\text{NH}_2, \text{ exchangeable with deuterium}), 3.91 (s, 3\text{H, } -\text{O-CH}_3), 1.26 (s, 3\text{H, } C_{10}\text{-CH}_3), 0.76(s,3\text{H, } C_{13}\text{-CH}_3), 0.94, 0.84 and 0.81 \text{ side chain methyl protons).}
Reaction of 4β-bromo-5-methoxy-5α-cholestan-3-one (CLXIV) with urea: 2'-Amino-5-methoxy-5α-cholest-3-eno-(3,4-d) oxazole (CLXVI):

The bromoketone (CLXIV, 0.5g) was treated with urea in ethyl alcohol in the similar fashion as was treated with thiourea and worked up. The product obtained after work up was crystallised from petroleum ether to provide the crystals of 2'-amino-5-methoxy-5α-cholest-3-eno-(3,4-d) oxazole (CLXVI, 0.29g), m.p. 92-94°C.

Analysis Found: C, 75.16; H, 10.61; N, 6.25
Required: C, 75.68; H, 10.81; N, 6.31%
IR: \( \nu_{\text{max}} = 3280(\text{NH}_2), 1620(\text{C}=\text{C}), 1570(\text{C}=\text{N}), 1355(\text{C}=\text{N}), 1265 \text{ & } 1060 \text{ cm}^{-1} (\text{C}=\text{O}). \)

\( ^1\text{H-NMR} \): \( \delta \) 5.1 (brs, 2H, \(-\text{NH}_2\), exchangeable with deuterium), 4.2 (s,3H, \(-\text{O-CH}_3\)), 1.31(s,3H,\text{C}_{10}-\text{CH}_3), 0.76 (s,3H,\text{C}_{13}-\text{CH}_3), 0.76, 0.84 and 0.92 (side chain methyl protons).

Reaction of cholesterol (LVIII) with pyridinium dichromate (PDC): Cholest-4-en-3,6-dione (LXXIII):

To a solution of cholesterol (LVIII, 10 g) in N,N-dimethyl formamide (220 ml) pyridinium dichromate\(^{65}\) (PDC, 44g) was added and the reaction mixture was stirred at room
temperature for 4 hours. The reaction was monitored with the help of TLC plates. After completion of the reaction water (2200 ml) was added and the reaction mixture was worked up with ether. The ethereal layer was washed with water, dilute hydrochloric acid, sodium bicarbonate solution (5%) and water and dried over anhydrous sodium sulfate. Evaporation of the solvent provided the yellow solid which was crystallised from methanol to give the diketone (LXXIII, 8.7g) m.p. 124°C (reported m.p. 122-123°C).

Analysis Found : C, 81.64; H, 10.30
Required : C, 81.41; H, 10.55%
U.V. : \( \lambda \) max 250.8 nm.
IR : \( \gamma \) max 1695(C=O), 1605 cm\(^{-1}\) (-C=C-).

\(^1\)H-NMR (CDCl\(_3\)) : \( \delta \) 6.15 (s,1H,C\(_4\)-vinyl proton), 2.66 (dd, 1H C\(_7\)-\( \beta \) H, pseudo equatorial, Jae = 5Hz, \( J_{Gem} = 19 \) Hz), 2.49 (m,2H,C\(_2\)-2\( \alpha \) H), 2.12 (m,2H,C\(_1\)-2\( \beta \) H), 2.02(dd,1H,C\(_7\)-\( \alpha \) H, pseudo axial, Jae=5 Hz, \( J_{Gem} = 19 \) Hz), 1.15 (s,3H,C\(_{10}\)-CH\(_3\)), 0.71 (s,3H,C\(_{13}\)-CH\(_3\)), 0.91(d,3H,C\(_{20}\)-CH\(_3\)), 0.86 and 0.84 (for other methyl protons).
Reaction of cholest-4-en-3,6-dione (LXXIII) with N-bromosuccinimide in presence of benzoyl peroxide (catalyst): 2\(\alpha\),7\(\alpha\)-Dibromocholest-4-en-3,6-dione (CLXVII):

To a solution of cholest-4-en-3,6-dione (LXXIII, 2g) in dry benzene (60 ml), N-bromosuccinimide (2g) was added.
under refluxed condition in small portions over a period of 3 hours in presence of benzoyl peroxide (as catalyst). After complete addition, the reaction mixture was further heated for 1 hour and then the solvent was evaporated under reduced pressure. The residue so obtained was taken in ether. The ethereal layer was washed with water, sodium sulfite solution (5%) and water successively and dried over anhydrous sodium sulfate. Removal of the solvent provided a brown solid which was chromatographed over silica gel in a column. Elution with petroleum ether: ether (8:1) provided a white solid compound which was crystallised from methanol to afford the dibromoketone (CLXVII, 1.52 g) m.p. 180°C.

Analysis Found : C, 58.02; H, 7.04

Required : C, 58.27; H, 7.19%

U.V. : \( \lambda_{\text{max}} \) 240.8 nm.

IR : \( \nu_{\text{max}} \) 1700 (C=O), 785 cm\(^{-1}\) (C-Br)

\(^{1}\text{H-NMR (CDCl}_3\) : 6.32 (s,1H,C\(_4\)-H vinylic), 4.85 (dd,1H,C\(_2\)-\(\delta\)H, \(J_{aa} = 5\) Hz, \(J_{ae} = 14\) Hz), 4.38(d,1H,C=\(\delta\)H, \(J_{ae} = 3\) Hz), 2.7(dd,1H,C\(_1\)-H, \(J_{ae} = 5\) Hz, \(J_{Gem} = 14\) Hz), 2.46 (t,3H,C\(_1\)-H, \(J_{aa} = J_{Gem} = 14\) Hz), 1.24 (s,3H,C\(_{10}\)-CH\(_3\)) 0.92 (d, 3H, C\(_{21}\)-CH\(_3\)), 0.87 & 0.85 (other methyl protons of C\(_{26}\) & C\(_{27}\)) and 0.74 (s, 3H, C\(_{13}\)-CH\(_3\)).
$^{13}$C-NMR: $C_1(47.4651)$, $C_2(49.1342)$, $C_3(190.377)$, $C_4(126.544)$, $C_5(159.316)$, $C_6(193.994)$, $C_7(57.6270)$, $C_8(43.2928)$, $C_9(37.6693)$, $C_{10}(42.2525)$, $C_{11}(20.3693)$, $C_{12}(38.3238)$, $C_{13}(43.4298)$, $C_{14}(51.8922)$, $C_{15}(23.7273)$, $C_{16}(27.750)$, $C_{17}(55.6450)$, $C_{18}(12.2957)$, $C_{19}(18.6197)$, $C_{20}(35.6235)$, $C_{21}(18.3919)$, $C_{22}(35.9789)$, $C_{23}(22.8054)$, $C_{24}(39.4325)$, $C_{25}(28.0040)$, $C_{26}(22.8054)$, $C_{27}(22.5396)$.

Mass: $M^+ 554(56)$, $M+2, 556(100)$, $M+4, 558(51)$, $553(6)$, $552(7)$, $477(35)$, $475(33)$, $474(30)$, $473(14)$, $472(5)$, $460(4)$, $397(6)$, $396(12)$, $395(24)$, $394(8)$, $393(9)$, $380(4)$, $367(5)$, $362(9)$, $360(7)$, $352(4)$, $322(4)$, $320(6)$, $306(7)$, $288(10)$, $282(11)$, $280(4)$, $272(6)$, $268(11)$, $267(3)$, $255(4)$, $254(8)$, $253(4)$, $252(7)$, $250(6)$, $246(19)$, $244(7)$, $242(6)$, $240(9)$, $238(9)$, $228(9)$, $226(11)$, $225(8)$, $224(10)$, $223(5)$, $222(6)$, $220(4)$, $218(7)$, $214(17)$, $213(6)$, $212(16)$, $209(7)$, $210(11)$, $208(9)$, $206(7)$, $202(9)$, $201(8)$, $200(12)$, $199(6)$, $198(16)$, $197(7)$, $196(15)$, $195(7)$, $194(9)$, $192(8)$, $191(3)$, $190(10)$, $189(8)$, $188(29)$, $187(9)$, $186(33)$, $185(9)$, $184(16)$, $183(8)$, $182(14)$, $181(9)$, $180(13)$, $179(7)$, $178(13)$, $177(14)$, $176(11)$, $175(25)$, $173(12)$, $172(35)$, $171(10)$, $170(25)$, $169(9)$, $168(18)$, $167(14)$, $166(24)$, $165(27)$, $164(32)$, $163(9)$, $162(21)$, $160(30)$, $159(16)$, $158(35)$, $157(14)$, $156(22)$, $155(20)$, $154(37)$, $153(93)$, $152(30)$, $151(32)$, $150(20)$. 
Reaction of $2\alpha,7\alpha$-dibromocholest-4-en-3,6-dione (CLXVII) with thiourea: $2',2''$-Diaminocholest-4-en-2,6-dieno(3,2-d and 6,7-d)dithiazole (CLXVIII):

A solution of $2\alpha,7\alpha$-dibromocholest-4-en-3,6-dione (CLXVII, 1g) and thiourea (0.3g) in alcohol (20 ml) was heated under reflux for 6 hours in presence of p-toluene sulfonic acid. After 6 hours the solvent was evaporated under reduced pressure and the residue obtained was taken in ether. The ethereal layer was washed with water, sodium bicarbonate solution (5%) and water. Dried over anhydrous sodium sulfate. Removal of the ether gave a light brown solid which was crystallised from methanol to afford the dithiazole (CLXVII, 0.86g), m.p. 207°C.

Analysis Found: C, 67.76; H, 8.42; N, 10.90
Required: C, 67.97; H, 8.59; N, 10.94%
IR: $\nu_{\text{max}}$ 3260 (-$\text{NH}_2$), 1625 (C=C) 1545 (C=N), 1370 (C-N), 670 cm$^{-1}$ (C-S).

$^1$H-NMR: $\delta$ 6.47 (s, 1H, C$_4$-vinyl proton), 5.35 (brs, 4H, exchangeable with deuterium, -$\text{NH}_2$), 1.18 (s, 3H, C$_{10}$-CH$_3$), 0.78 (s, 3H, C$_{13}$-CH$_3$), 1.02, 0.88 and 0.84 (other side chain methyl protons).
Reaction of 2α, 7α-dibromocholest-4-en-3,6-dione (CLXVII) with urea : 2'-Amino-2α-bromocholest-4-en-6-eno (6,7-d) oxazole (CLXIX):

A solution of 2α, 7α-dibromocholest-4-en-3,6-dione (CLXVII, 1g) and urea (0.22g) in alcohol (20 ml) was heated under reflux for 8 hours in presence of p-toluene sulfonic acid. After workup in the usual manner, a non-crystallizable amorphous solid of bromo oxazole (CLXIX, 0.7g) was obtained with m.p. 156°C.

Analysis Found : C, 64.61; H, 8.13; N, 5.36
Required : C, 64.74; H, 8.28; N, 5.39%

IR : \[ \nu_{\text{max}} \] 3280 (\(-\text{NH}_2\)), 1700(C=O), 1610 (C=C), 1550(C=N), 1330(C-N), 1270,1050(C-O), 775 cm\(^{-1}\) (C-Br).

\(^1\text{H-NMR}\) : \[ \delta 6.44 \text{ (s,1H, C}_4\text{-vinyllic proton),} \]
5.0(dd,1H, C\(_2\)\text{H} J\(_{ae}\)=5 Hz; J\(_{aa}\)=14 Hz), 4.46 (brs, 2H, exchangeable with deuterium,-\text{NH}_2), 1.32 (s,3H, C\(_{10}\)-CH\(_3\)), 0.77 (s,3H,C\(_{13}\)-CH\(_3\)), 1.02, 0.96 and 0.92 (other side chain methyl protons).

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