regional accounts deal with some 240 species and recognise 26 distinct subgenera or sections, however, the world-wide account of De Candolle (1824) treats 159 species and classifies them in five sections.

They are annual or perennial herbs. Radical leaves are long stalked and usually lobed. Stem leaves are smaller and usually stalked. Flowers are regular, panicked with sepals 5, green, imbricate, soon falling off; petals 5, yellow, shining, imbricate each with a pocket-like nectary at the base on the upper surface; stamens numerous and carpels several or many, each 1 ovuled in a globose or oblong head with a short style. Fruit is a head of small achenes, sometimes flattened, and the tips of the persistent styles is often hooked.

Recent taxonomic work on Ranunculaceae of Eastern Asia is by Tamura (1962a, 1962b, 1966, 1967, 1968). He considers the genus Ranunculus to be more derived than Caltha L., Trollis L. as well as Callianthemum C.A.M.

Observations

1 - Ranunculus adoxifolius Hand.-Mzt.

The material available for study was herbarium material which had very few flowers. Just four flowers i.e. 20 petals were in good condition and could be studied. All other flowers
were not in a suitable condition for study, however, the study of partially damaged flowers helped to have a better understanding about venation.

Petals are generally broadly ovate with a narrow basal stalk. The length of the stalk is 0.4 to 0.6 mm. and from the level of the nectary to the apex of the petal it is between 3.2 mm. to 5.0 mm., accordingly the breadth varies from 2.6 mm. to 4.5 mm. The small sized petals have an oblong or even obovate shape.

The vasculature is very simple. A single vein on entering the petal divides into three basic components which can be resolved into the left costal, median and right costal. In the large sized petals, the median vein is divided into two and the branching takes place in the basal sector. The costals give off a number of branches and all the branches are disposed on the peripheral side. These branches further dichotomise. In the smaller sized petals the median is unbranched and the two costals give less number of branches, which may or may not further dichotomise. In general the venation is open dichotomous.

Although 20 petals have been under study, only in two petals vein anastomosis has been found. In two large sized petal, anastomosis of Type II of Foster is seen. In one petal (Pl. 1 - f.1) the areole formed is restricted to the basal sector, while in the other petal (Pl. 1 - f.4) the areole that is formed as a
result of the anastomosis extends from the basal sector to the peripheral sector.

As very few petals have been studied, no attempt is made to work out the percentage of anastomosis or further details.

2 - Ranunculus brotherusii Freyn

Flowers from herbarium specimens in good quantity have been studied. A number of flowers were detached, soaked in water and kept in an incubator at 25°C. Few drops of 0.5% KOH were added to make the material swell. Later petals were detached from the receptacle and preserved in vials containing 70% alcohol.

Great variations have been observed, such as normal petals, petals with one side polliniferous, petaloid stamens of different sizes with one or both sides having polliniferous sacs, normal stamens with broad filaments and finally perfectly normal stamens.

I. An account of the normal petals is first given.

Thirty seven petals have been studied. Not all petals are of the same size, the smallest being 3.5 mm. base to apex in length and 1.4 mm. broad and the largest ones being 5.4 mm. by 3.8 mm. Accordingly the shape is also variable, some being elliptic, others obovate and some even approaching orbicular.

The vasculature is very simple in the small sized petals (Pl. 2 - f. 1 - 3). A vein on entering the petal divides twice resulting in a median and two costals. The median runs for some
distance and then either in the peripheral or even in the central sector gives off one or two branches. The two costals are either sparsely branched or may give off a number of branches. In larger sized petals the median does not show any deviation from the previously stated condition. However, the costals are more profusely branched (Pl. 2 - f. 4, 5). The branching in all the petals is dichotomous and open. No anastomosis has been seen in any of the petals.

II. A detailed account of the petaloid stamens is given below. Nine flowers showed various degrees of abnormalities e.g.,

Five flowers - each had
i) 5 normal sepals present
ii) No normal petals present
iii) 5 to 6 petaloid and subpetaloid stamens which were rolled up.
iv) Normal stamens many.
v) Many carpels on an elongated thalamus.

One flower -

i) 5 normal sepals present.
ii) One normal petal present.
iii) Two small petals, each with one side polliniferous.
iv) Two petaloid stamens, smaller size, and having both sides polliniferous.
v) Normal stamens many but stamens on the outer whorl with broad filaments.

vi) Many carpels on an elongated thalamus.

One flower with -

i) 5 normal sepals.

ii) 1 normal petal.

iii) 1 smaller petal with one side polliniferous.

iv) 3 petaloid stamens, still smaller in size and having both sides polliniferous.

v) Few normal stamens.

vi) Many carpels on an elongated axis.

One flower with -

i) 5 normal sepals.

ii) No normal petals.

iii) 5 petaloid stamens.

iv) 1 stamen with one anther lobe.

v) Normal stamens many.

vi) Many carpels on an elongated axis.

One flower with -

i) 5 normal sepals.

ii) No normal petals.
iii) 5 petaloid stamens.
iv) Normal stamens few.
v) Many carpels on an elongated axis.

The petaloid stamens (Pl. 5 - f. 3, 4) which have one side polliniferous have a very simple vasculature. A single vein on entering divides twice to give rise to a median and two costals. The median gives off another branch at the level where the nectary is present. The costals are unbranched or may be branched once (Pl. 5 - f. 3, 4).

The petaloid stamens which have both sides polliniferous (Pl. 3 - f. 1-3; Pl. 4 - f. 1, 2, 4; Pl. 5 - f. 1, 2) are also very simple in their vasculature and similar to a very great degree to the previous petaloid stamens. However, some petaloid stamens have still simpler vasculature (Pl. 3 - f. 3; Pl. 4 - f. 1, 2) being reduced to an unbranched median and unbranched costals. Some staminodes that approach the normal stamens in size and shape (Pl. 5 - f. 5, 6) have a single trace which gives off one or two branches. Stamens with broad filaments (Pl. 4 - f. 3; Pl. 5 - f. 7, 8) have a single trace similar to the normal stamens. Staminode with a single anther lobe and very much like the stamens of some monocots is also seen amongst the normal stamens (Pl. 4 - f. 5).

It is of great interest and of deep significance to find
that there are normal sepals and normal carpels but there is a regular gradation between the normal stamens and normal petals (or vice versa) in each flower. Further, the petaloid stamens have a simpler vasculature as compared to the normal petals. Staminodes grading to normal stamens are found.


The present study has been on 180 petals. Petals are obovate with a nectary at the base. The length of the petals is from 4 to 6 mm. with an average of 5 - 5.5 mm. Breadth is from 2.5 to 3.5 mm., with an average of 3 mm. The vasculature can be reduced to three basic components - the left costal, the median and the right costal. The vein on entering the organ undergoes two dichotomies very near to each other. The median divides 3 or 4 times, but once branching or even 5 times also occur. In most cases the branching is anisotomous but isotomy is also seen in some petals. The costals divide and subdivide a number of times, generally 4-8 dichotomies are frequent. The venation is open dichotomous.

The region of anastomosis is usually the central or peripheral. In rare cases the anastomosis is in the basal region. Anastomosis between sister shanks of the left costal may take place or between the sister shanks of right costal. The anastomoses are mostly of type V of Foster but types I, II, III & IV
are also present. Type IV is of rare occurrence and is followed by Type I & Type III. Type II ranks as the second frequent type of union. Arnott & Tucker's type 'A' is seen in some petals (Pl. 48 - f.11).

A branch from a costal may fuse with the median or with one of its branches (Pl. 49 - f. 8b, f.9a; f. 10a, f.11b; Pl. 50 - f. 1a, f. 2a, f. 3a, f. 4b, c; f. 5a, f. 6b, c, f. 7c, f. 8b, f. 9c, f. 10a). Similarly a branch from the left costal or a branch from the right costal may anastomose with a sister branch and the resulting situation is the formation of an areole. They give rise to 'areoles' lying side by side (Pl. 49 - f. 3ab, f. 9bc). The region of anastomosis may be the central or peripheral sector. What is most striking is that two/three shanks are given off before an anastomosis (Pl. 48 - f. 8; Pl. 49 - f. 9a). The presence of 2 areoles lying side by side (Pl. 49 - f.3, f.9 & Pl. 50 - f.7, f.9, f.11) have been seen. One free veinlet is found in an areole in some petals (Pl. 50 - f.10a; Pl. 51 - f.3a, f.4a). Out of 100 petals, forty have one anastomoses, 30 have 2 anastomoses, 22 with 3 anastomoses and 8 petals with 4 anastomoses.

What has been termed as fasciculatio vasorum inversus by Daumann et al (1970) is present in one petal of this species (Pl. 49 - f.3).
Banerji (1972, 1976) has studied this species in great details. Thus the present study has been rather restricted to the study of 300 petals in addition to the 500 petals studied by Banerji and the 125 diagrams that were sent to the late Prof. Foster. Attention having been focused on features that were not observed by Banerji or little attention paid by him. Late Prof. Foster's comments have been of immense help to me.

The petals are of a variable size and shape. The largest petals being 10 mm. by 4.4 mm. and the smaller ones being 5.2 by 3.2 mm. The shape accordingly is obovate, ovate and in some cases oblong.

The basic components of the vasculature are the two costals and the median. The first two dichotomies are at the base of the petal, so that in most cases it appears as if the two costals arise opposite to each other. The median vein branches twice or thrice and the costals branch a number of times. Type Va of Foster is the most common, however, other types are also present. The present observations in general are in accordance with those of Banerji (1976).

In some petals anastomosis takes places between the sister branches of the median (Pl. 7 - f. 2,7) while in some others a branch from the right costal anastomoses with a branch from the median (Pl. 6 - f.3; Pl. 7 - f. 1,7).
Yet another interesting feature is the presence of free veinlet in an areole (Pl. 6 - f.3-a), an observation already made by Banerji (1976) who had also observed such free veinlets where distinctly closed areoles had not been formed. In the present study as also on re-examination of Banerji's slides, free vein endings are seen in some closed areoles. It is observed that when an areole is formed by vein union, there are some additional shanks about which late Prof. Foster had commented 'very interesting'. In a personal communication he had also suggested to Dr. Banerji that more detailed study may reveal this condition as a variation. I have dealt on this under 'Discussion'. Foster had used the term 'blind vein ending' which however is incorrect. Unconnected vascular strands, as recorded by Foster in the leaves of *Circaeaester agristis* (see Foster, 1968 - pl II - f 12(us); pl IV - f 16(us); pl V - f 23(us); 1970, pl V - f 19(s) are also present in the petals of this species (Pl. 6 - f. 3, 8 & 9; Pl. 7 - f. 3, 4, 5 & 6).

It is of interest that some anastomoses as observed by Banerji (1970) that did not fit in any of the types of Foster (indicated in Banerji, 1970 - figs. 13, 14, 15 & 16) are also seen in the present study (Pl. 6 - f. 5a, 5b). That two or three anastomoses follow each other and result in a situation that had been remarked as 'equally very interesting' by late Prof. Foster (his personal communication to Prof. Banerji) is frequently seen...
in the present study (Pl. 6 - f. 4, 5, 6, 8; Pl. 7 - f. 3, 4, 6, 7). It may be noted that such successive anastomoses are present only in the costals.

5 - Ranunculus hirtellus Royle

The following observations are based on a study of 60 petals.

The petals are broadly obovate in shape and a nectary is present a little above the base. The margin is faintly serrulate. The length is 6-10 mm. and breadth is 5 to 9 mm. Some petals have a shallow notch at the apex.

The venation is open and dichotomous. A trace on entering the petal undergoes two divisions. As these two divisions are very near to each other, in most of the petals it appears as trichotomous. A median and two costals are clearly made out a little above. The median vein usually gives off 3 to 5 branches which are disposed in the central and peripheral sector. However in some cases branches are given off in the basal sector. Rarely the median is unbranched. Occasionally anastomosis of sister branches of the median takes place (Pl. 11 - f. 2d; Pl. 12 - f. 1c).

Branch or branches of the median vein unite with branch or branches of the costals and give rise to areoles. Anastomoses are generally of Type Y of Poster (Pl. 9 - f. 7b; Pl. 10 - f. 1a,b, f.4a,b, 5b, c; f. 6c, f. 7d, f. 8c; Pl. 12 - f. 1c, d, f. 2d,
f. 3b, f. 4b, f. 6a).

The costals divide repeatedly and usually the number of dichotomies is between 10 to 12 but may be as many as 15. Anastomosis between sister branches of a costal is frequent. There may be one point of anastomosis or as many as 6, and these are distributed over the petal surface. The region of anastomosis may be in the basal, central or even in the peripheral sector; similarly it may be along the median or left costal or right costal.

An outstanding situation is seen in most of the petals where two or three shanks arise before an anastomosis which may be of Type V or Type V (Pl. 8 - f. 7a, f. 8a; Pl. 9 - f. 2a, f. 3a, f. 9b; Pl. 10 - f. 1b; Pl. 12 - f. 3a, f. 4a, f. 7a).

Another interesting feature of the vasculature of the petals of R. hirtellus is the occurrence of successive areoles (Pl. 11 - f. 2, f. 3; Pl. 12 - f. 1, f. 2). A significant observation is the presence of a free vein within an areole (Pl. 12 - f. 5a). The Type V anastomosis is the most prevalent one and Type IV is the least, Type II ranks as the second.

6 - R. laetus Wall. ex Royle

The study of this species has been over 200 petals.

The petals are broadly ovate with a nectary at the base. The largest petal is 13 mm. long and 9 mm. broad while the small
sized petal is 6.5 mm. by 5 mm; the usual size is 10-12 mm. in length and 7.5 - 8.5 mm. in breadth.

Basic components of the vasculature can easily be reduced into a left costal, median and a right costal. A single trace on entering the petal divides into three main branches. The median dichotomises a number of times and the number of dichotomies are usually from 16 to 25. Similarly the costals divide and subdivide resulting in 17-25 branches on either side of the petal. The venation pattern is open dichotomous.

Anastomoses between veins is very frequent. A branch from a costal vein anastomoses with a sister branch of the same costal or it may anastomose with a shank belonging to the median vein. Similarly sister branches of the median may unite amongst themselves. The unions follow all the five types of Foster. Based on the 93 petals as illustrated, Type V is present in 370 places, Type IV at 65, Type III at 20, Type II at 113 and Type I at 39 points. Thus it follows that Type V is the most prevalent and is followed by Type II. Of least occurrence is Type III. There are some 34 anastomoses which do not agree with Foster's Types. Some 20 anastomoses agree with Arnott & Tucker's types, type B can be seen at Pl. 31 - f.1h; Pl. 33 - f.2h; Pl. 38 - f.2i; Pl. 39 - f.2 o. Similarly type C' at Pl. 27 - f.3f; Pl. 29 - f.1i; Pl. 30 - f. j and Pl. 35 - f.2m. Type C'' is present at Pl. 15 - f.3b; Pl. 25 - f.2f and a few places more. Another 7 follow Melville
such as at Pl. 30 - f.3g, Pl. 37 - f.1e and Pl. 39 - f.1 o are type 13 (of 1969) while Pl. 36 - f.1i has type 10 and Pl. 30 - f.2c the 9th type. There are 5 that are in agreement with Slavikova's types as evidenced by Pl. 27 - f.1d and f.3c and also Pl. 28 - f.3f show type 1 while at Pl. 32 - f.3f is type 5 and at f.3g it is 3. However it may also be mentioned that some types of Melville coincide with Arnott & Tucker's forms and there are 6 such forms of anastomoses which can be seen at Pl. 19 - f.2c showing B of Arnott & Tucker as also 9 of Melville. Similarly at Pl. 31 - f.1j the union can be classified as C of Arnott & Tucker as also 13 of Melville. Similarly some of Arnott & Tucker's types have similarity with Slavikova's types and in the present study 3 such unions have been observed for example Pl. 21 - f.3d is C of Arnott & Tucker and also 5 of Slavikova; another example is on Pl. 42 - f. 42 - f.3c which is Arnott & Tucker and 5 of Slavikova. A petal with no anastomosis of veins is very rare. The number of anastomosis are as many as 17. It is in the central sector that the union of veins is most frequent, however, in the peripheral sector anastomosis of veins is also present. In the basal sector the unions are equally frequent. Out of 93 petals illustrated showing 1 to 17 anastomoses in each, there are 87 petals with successive areole formation and with a total of 550 anastomoses. As illustrated there are 4 petals with 16 anastomoses e.g., Pl. 41 - f.1. Usually 4 to 7 points of union are encountered in petal. There are some petals in which on the left costal there are 5 to 6 anastomoses and on the right costal as well there is an equal number
of anastomoses. In short it may be said that 50% of the petals have 7 or more anastomoses and 10% have 14-16 anastomoses, see Pl. 36 to Pl. 41 - f.1.

An interesting situation is presence of a free veinlet in an areole. In a single petal there may be 4 to 5 areoles each with a free veinlet (Pl. 27 - f.2, f.3; Pl. 38 - f.1; Pl. 39 - f.1 and many others). There are 60 areoles each with a single free vein. Equally interesting is the presence of 2 free veinlets in a single areole (Pl. 27 - f.3; Pl - f.3, Pl. 37 - f.1-i; Pl. 41 - f.2, f.3; Pl. 42 - f.2, f.3). Even in one areole 3 free veinlets have been seen (Pl. 42 - f.2-b) but this has been observed only in one petal during the entire study.

Equally interesting is the presence of an areole within another larger areole. (Pl. 19 - f.3c inside b; Pl. 21 - f.2 d inside b).

A very interesting situation is seen when there are a number of "side shanks" before the union of two shanks. The result is an areole which has on its one side 2 or 3 or even 4 "side shanks". This situation was first noticed by Banerji (1976) in *R. diffusus* and was commented upon by Foster in a personal communication as "a very interesting situation". In *R. laetus* the occurrence of such 'side shanks' seems to be fairly common, being as many as 125 in 200 petals out of which 93 have been illustrated. Some of these side shanks fuse amongst themselves and form
The petals are oblong or ovate in shape, having a distinct stalk, a pocket shaped nectary is present. The main body of the petal i.e., from the level of the nectary to the apex the length of the petal is on an average 2.6 mm. and the breadth is 1.6 mm. However, depending on the maturity of the flower such as a bud that has just opened, the size of the petal is smaller.

Each petal receives a vascular bundle which runs for a little distance, dichotomises twice and gives off a costal vein on either side. The median may branch at any level or may run upwards without giving any branch (Pl. 45 - f.3). The costals may branch once or may remain unbranched. The branching when present is dichotomous and open and the vasculature is very simple.

9 - Ranunculus pulchellus C.A. Mey.

50 petals of this species have been studied because of limited material available which was in the form of dry herbarium specimens collected in a remote part of northern Nepal.

The petals are oblong or obovate in shape with a distinct claw. A little above the claw, on the adaxial surface a pocket shaped nectary is present. The length of the claw i.e., from the base to the middle of the nectary is 1.5 to 1.9 mm. The body of the petal is 3.3 mm. to 3.8 mm. in length and 1.2 to 1.8 mm. broad. Rarely the petals are very big, being 4.6 mm. long and 4.2 mm. broad (Pl. 46 - f.1,2). In such petals the claw is not very distinctly
marked. A number of variations have been observed in the flowers of the species.

The vasculature of the petals is very simple and can be reduced into a median, the left costal and the right costal. The branching is open dichotomous. The median vein runs unbranched or it may give off one, two or even four branches. These branches do not further divide. The two costals give off two, three or more branches towards the periphery (Pl. 45 - f.5-9). In petals that are of a bigger size the costals give off branches towards the periphery as well towards the median axis (Pl. 46 - f.1, 2). These branches further branch and a number of shanks are given. No anastomosis has been seen in any of the 50 petals studied. However a number of interesting variations in the petals has been studied.

Material identified as *Ranunculus pulchellus* var. *stracheyanus* (Maxim) Hand-Mazz. has also been studied. Due to paucity of material available, some 30 petals have been studied. The petals are slightly larger than the petals of the typical material (Pl. 46 - f.3,4). The median vein is unbranched and the costals give off a variable number of branches towards the peripheral side. The shanks may or may not branch further. Only in one petal (Pl. 46 - f.4a) an anastomosis has been seen. This anastomosis is of Type V< of Foster. Interesting as it is the anastomosing branches are on the median side and they are the sister branches of the same costal (left costal), further the areole thus formed extends from the basal to the
A detailed account of the variations seen in the flowers of the species is given below.

Two flowers, each of which have
1) 5 normal sepals
2) 5 normal petals
3) 2 petaloid stamens,
4) Normal stamens many, some with branched vein
5) Carpels many on an elongated thalamus.

Three flowers, each of which has
i) 5 normal sepals
ii) 5 normal petals
iii) 1 stamen with one anther lobe
iv) Normal stamens many, some with branched vein and flattened filament.
v) Carpels many on an elongated thalamus.

The vasculature of the petaloid stamens is much simpler than the vasculature of the normal petals. However a median and two costals can be differentiated.

A stamen, with a falcate shape and only one anther lobe, has a flattened filament. A single vascular trace is present which gives off two branches about the middle of the filament (Pl. 47 - f.2). Some of the normal stamens show deviations from the usual
condition in their vasculature. Although a single vascular trace enters the filament and continues as such towards the distal end, it gives off a branch which runs for a short distance and then ends. The filaments of such \textit{stamens} are flattened (Pl. 47 - f.1, 3).

10 - \textit{R. salsuginosus} Pallas ex Georgi forma \textit{incisa} (Baranov) Hara.

Only 5 petals were available for study and it is not possible to say if all these 5 petals belonged to a single flower or to different flowers as the materials was collected in Nepal and sent to me.

The petals are more or less obovate in shape, some having a distinct narrowed base which is about 1 mm. long. From the nectary the length of the petal is 5.2 mm. and in breadth 3.4 to 4.6 mm.

A single vein, on entering the petal, divides sooner or later to form a median and two costals. The median gives off a branch in the basal sector which unites with a shank from the right costal and forms an areole (Pl. 52 - f.1a, 3a). The anastomosis may be of Type II (Pl. 52 - f.1a) or Type Vs, (Pl. 52 - f.3a). In the peripheral sector again the median branches. The costals divide a number of times. Some of the sister branches of the costals unite and give rise to areoles. Anastomoses may be of Type II (Pl. 52 - f.1b), Type IV (f. 2b) or Type Vc (f.3c) or even Type Vs (f.3d).

In one areole (Pl. 52 - f.3b) a free vein is present, moreover on the right costal side of this areole four branches arise.
and the type of anastomosis is Type II of Foster.

The anastomosis of the areole $d$ in fig. 1 - Pl. 52 does not fit any of the Types of Foster but Melville's type 6 (1969) or Slavikovas' 1 fit in perfectly. Similarly of areole $C$ in fig 2 also does not fit any of Foster's types. In this case Melville's type 10 (1969) fits well.

In this case also further analysis has not been attempted due to paucity of material.

11 - *R. sceleratus* Linn.

Petal venation of this species has been studied by Banerji & Mukherji (1970) thus this material has been studied, so to say cursorily, on 50 petals only.

The petals are more or less ovate with a very narrow basal constricted region. The length from the base to the nectary is $4 - .5 \text{ mm.}$ and from the nectary to the apex the length is $3 - 3.2 \text{ mm.}$ The breadth of the petal is on an average $2.2 \text{ mm.}$

The venation of the petal is simple. A single trace on entering the petal undergoes two successive dichotomies resulting in a median and two costals. The median remains unbranched in most of the petals. It may branch once in the peripheral sector. Rarely it may give off the branch in the basal sector (Pl. 53 - f.4,11 & 13) still more rare is the occurrence of two branches (f. 4) and only in one petal (f. 13) the median was seen to have branched 5 times.