Man-made niches

Man has inadvertently created a number of microhabitats in our towns. Among them walls, pavements and gravestones are all suitable substrates for colonisation by pioneer epiflora.

Probably the most stable of these man-made habitats are walls, and many old well colonised walls can also support a small population of invertebrates. However, even a well populated wall cannot be considered as a community, in the way that a pond or hedgerow can – it merely represents a microhabitat within a specific community.

Physical factors play a highly significant role in controlling the species diversity within these microhabitats. Only by investigation of these environmental factors and their interrelationships can the nature of these mini-ecosystems be understood.

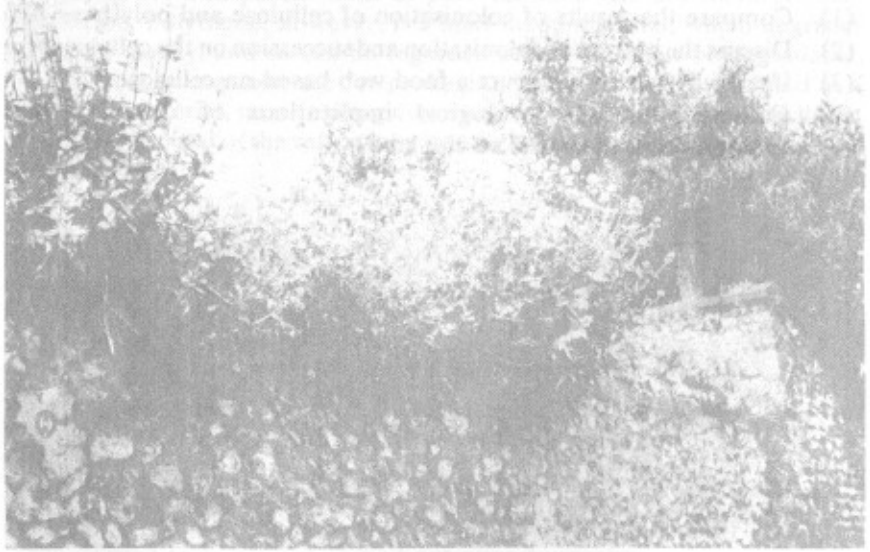


Figure 10 An old stone wall colonised by *Centranthus ruber*, red valerian, an introduced plant with pink or red flowers.

Exercise 10: an investigation of the epiflora of walls

Background

Most walls support some plant life but, in ecological terms, a wall is an extreme environment, resembling a cliff or rock face. Nevertheless, this harsh environment provides a niche in urban areas for species which otherwise would be rare or totally absent. Initially, the usually vertical surface of the wall, with no ledges or crevices, is inhospitable to plants. But the uneven decomposition of mortar and brick, by weathering, soon reveals crannies which provide the first foothold for colonisation. Clearly the materials of construction play a significant role in providing a suitable substrate for these pioneer plants. Most walls are built from brick, stone or concrete. The first two are normally mortar jointed and it is the difference in physical composition between brick or stone and mortar that creates these first crevices. Old walls jointed with lime mortar, which predominated until about 100 years ago, are the most heavily colonised. Portland cement walls are harder, and more weather resistant, and are unlikely to be colonised to any great extent.

Because of its harsh nature a wall, like many open habitats, is exploited by species which cannot compete successfully in a more moderate environment. Consequently xerophytes, cliff plants and rock plants are typical wall colonisers. Some old town walls support a much larger variety of species, in vigorous competition, where local conditions modify the extremes of this niche.

Aims

(a) To investigate the distribution of epiflora on walls.
(b) To determine the factors controlling distribution.

Materials

½-m-grid quadrat (Fig. 11); metre rule; plotting compass; graph paper; scalpel; sample tubes; universal indicator solution; soil testing kit; thermometer.

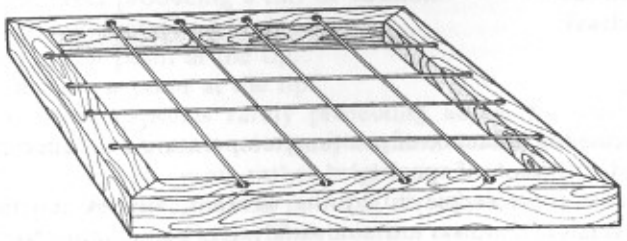


Figure 11 A grid quadrat: ½-m wooden frame with strings fixed at 10-cm intervals.

Time

2–3 h in the field; 1 h, plus drying time, in the laboratory.

Method

Old limestone walls in the summer will provide the most satisfactory results for this exercise. Select a suitable wall for investigation. Assess the vertical distribution of species by the following procedure:

(a) Make a complete species list, the identification chart (Fig. 12) illustrates some of the most common wall ferns and flowering plants. Keys can be used to identify the mosses and liverworts (page 29) and lichens (page 38).
(b) Note the aspect of each face of the wall.
(c) Place the quadrat at the base of one face of the wall.
(d) Using a suitable scale, draw a square on to the graph paper. Outline the position of the stones and mortar, then map the distribution of the species in the quadrat.
(e) Repeat the mapping procedure in the middle and at the top of the wall, noting the height above the ground in each case. (If a low wall is used, record the distribution at the base and the top of the wall only.)
(f) Record the distribution of species at the base, middle and top of the other face of the wall.

Collect a sample of 'soil' and analyse in the laboratory for pH value, lime, water and humus content. Record the air and surface temperatures on both sides of the wall at hourly intervals. Ideally, temperature readings should be taken until well after dark.

Study the flowering plants colonising the wall, and note their methods of attachment, dispersal mechanisms and any other adaptations they exhibit.

A second stone wall, with a different aspect, or a brick wall, could be selected for comparison and the investigation repeated.

Determine the percentage colonisation of the wall in each quadrat and present the results as a histogram.

Questions

(1) Discuss the influence of position, temperature and aspect on the vertical distribution of species.
(2) Discuss the role played by the weather, mosses and lichen in the conversion of mortar into soil. Analysis of a soil sample from the school grounds would make a useful comparison.

(3) How do flowering plants reach walls initially? Consider the dispersal mechanisms of the flowering plants, and try to account for their presence on the wall. Find out the dispersal mechanism of the ivy-leaved toadflax (*Cymbalaria muralis*).
(4) Comment on the xerophytic adaptations shown by many flowering wall colonisers.
(5) Try to discover which species probably originated as flora of rock faces or cliffs.
(6) Why do many animals find walls a useful refuge?
(7) Suggest any further investigation which could be carried out to determine how plants become established on walls.

N.B. The capstones and tops of walls are often made of a different material and can also be investigated using a smaller, preferably oblong, grid quadrat to determine the percentage colonisation.

Identification of the epiflora on walls

Groups

(a) Algae: *Pleurococcus*.
(b) Lichens: the key to the common gravestone lichens (Exercise 12) is useful for this investigation.
(c) Mosses and liverworts.

Key to some common wall bryophytes (after B. W. Barrett & J. E. Chatfield)

1 Plant thallose. liverworts
Plants leafy. **2**
2 Leaves arranged strictly in two or three ranks. leafy liverworts
Leaves not arranged strictly in ranks and leaves often with midribs (nerve). (mosses) **3**
3 Main stem erect producing a turf or cushion. cushion moss **4**
Main stem horizontal and braided. feather moss **8**
4 Leaf with a hair point at the tip. **5**
Leaf with no hair point at the tip. **7**
5 Short seta and capsules rarely projecting above the cushion.
Grey–green appearance. (grey cushion moss) ***Grimmia pulvinata***
Capsule on long seta, moss rather bright green when moist. **6**
6 Capsule long and slender and pointing directly upwards, leaves usually have a rounded edge. Twists into a corkscrew when dry.
(screw moss) ***Tortula muralis***

Capsule rather plump and hanging down from the tip of the seta. Also twists into a corkscrew when dry. Sometimes forms large bun-like cushions. (greater matted thread moss) ***Bryum capillare***

7 Leaves densely packed on the stem producing a plaited appearance. Grey–green in colour when dry. (silvery thread moss) ***Bryum argenteum***

Spreading leaves forming star-like tips to the plant, each leaf is traversed by a broad midrib. Bright green appearance. (beard moss) ***Barbula convoluta***

8 Leaves taper to a slender point, often curl when dry. Yellow–green shiny appearance. (silky wall feather moss) ***Homalothecium sericeum***

Leaves oval with fine serrated margins, spread out from the stem. Shiny, bright green or yellow–green appearance. (rough stalked feather moss) ***Brachythecium rutabulum***

N.B. New feather moss shoots which appear in the spring are frequently erect initially.

Figure 12 Identification chart of common wall plants (pp. 31–3).

Flowering plants

Other species include:

Araliaceae:	*Hedera helix*, ivy
Caryophyllaceae:	*Sagina procumbens*, pearlwort
	Cerastium glomeratum, sticky mouse-ear chickweed
	Arenaria serpyllifolia, thyme-leaved sandwort
Cruciferae:	*Erophila verna*, common whitlow grass
	Arabidopsis thaliana, thale cress
Compositae:	*Senecio squalidus*, Oxford ragwort
	Aster tripolium, sea aster
Valerianaceae:	*Centranthus ruber*, red valerian

Ferns

Other species include:

Cystopteris fragilis, brittle bladder fern
Asplenium adiantum, black spleenwort
Dryopteris filix-mas, common male fern

Flowering plants

***Geranium lucidum*, shining cranesbill**

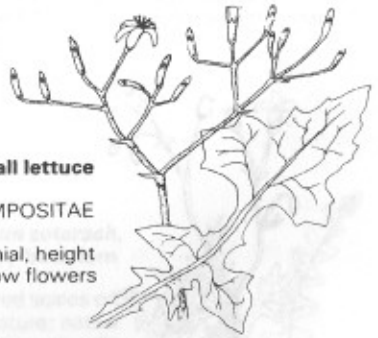
GERANIACEAE

Native annual, height up to 30 cm with pink flowers and waxy leaves; also common on paths and hedgebanks

***Cymbalaria muralis*, ivy-leaved toadflax**

SCROPHULARIACEAE

Creeping plant up to 70 cm, yellow flowers with purple and white centres; common except in the extreme north



***Mycelis muralis*, wall lettuce**

COMPOSITAE

Common native perennial, height up to 1 m with small yellow flowers

***Umbilicus rupestris*, wall pennywort**

CRASSULACEAE

Native perennial, height up to 30 cm with yellow flowers; common in western regions

***Diplotaxis muralis*, wall rocket**

CRUCIFERAE

Alien, height up to 50 cm with yellow flowers; common in south-west England and also found on wasteland

***Sedum album*, stonecrop**

CRASSULACEAE

Introduced perennial, height up to 15 cm with white flowers, often tinged pink; not common

***Cheiranthus cheiri*, wallflower**

CRUCIFERAE

Height up to 50 cm with variable flower colour; alien perennial naturalised on walls and rocky places throughout Britain

***Saxifraga tridactylites*, rue-leaved saxifrage**

SAXIFRAGACEAE

Native annual, height up to 12 cm with white flowers; quite common

***Veronica arvensis*, wall speedwell**

SCROPHULARIACEAE

Common native annual, height up to 20 cm with blue flowers

Figure 12 – *continued*

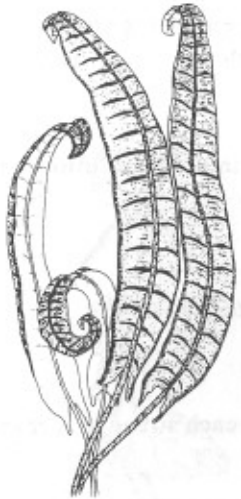
Ferns

***Asplenium ruta-muraria*, wall rue**

Native species, fronds 2 to 15 cm in length; fairly common on walls and rocks everywhere

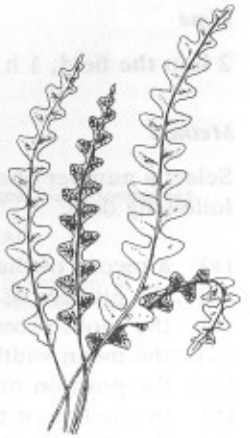
***Asplenium trichomanes*, maidenhair spleenwort**

Native species, fronds with black stalks 5 to 35 cm long; common in western Britain



***Asplenium ceterach*, rusty-back fern**

Fronds with rust-coloured scales on the underside when mature; native species grows in the mortar of walls



***Asplenium* (*Phyllitis*) *scolopendrium*, hart's tongue fern**

Strap-shaped fronds 10 to 60 cm long with pairs of long narrow sori; common native species on calcareous substrates

Figure 12 – *continued*

Exercise 11: an investigation of the species distribution between paving stones

Background

Paving stones bear some relationship to rock ledges, and could be considered as horizontal walls, except that they possess a number of special characteristics peculiar to this niche. When there is no mortar between paving stones, water collects in the cracks, together with any nutrients washed from buildings and walls, providing a more hospitable environment than a wall. The nitrogen content of the substrate between the paving stones is further enhanced by the large amounts of urine and faeces deposited by dogs. Plants which colonise paving stones must also tolerate trampling, and often exhibit the morphological characteristics associated with this factor.

Aims

(a) To determine the distribution of species between paving stones.
(b) To ascertain the factors controlling distribution.

Materials

1-m quadrat; rule; trowel; specimen tubes; Universal indicator solution; soil testing kit.

Time

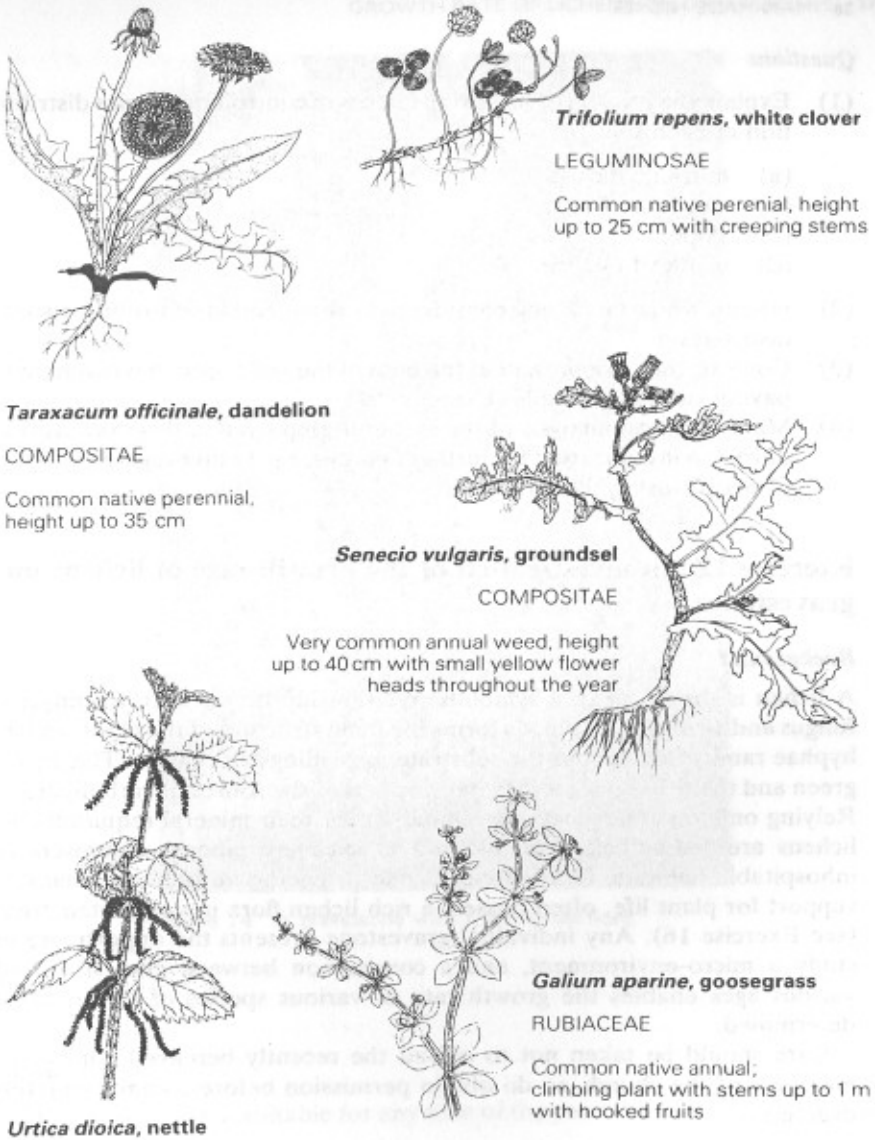
2 h in the field; 1 h, plus drying time, in the laboratory.

Method

Select a number of old streets with paving stones. In each street collect the following data:

(a) a record of the number and species of plants in 1 m²;
(b) the number of rosettes (see Exercise 6 & Fig. 6);
(c) the root : shoot ratio of common species (see Exercise 6);
(d) the mean width of the crevices;
(e) the position of the pavement with respect to buildings, trees, etc.;
(f) the incline of the street (if any);
(g) the pH value, humus and nitrate content of a 'soil' sample (collect the sample and analyse in the laboratory);
(h) a list of the plants found at the junction between the pavement and an adjacent wall or building (Fig. 13).

Analyse the quadrat results graphically.



***Trifolium repens*, white clover**

LEGUMINOSAE

Common native perenial, height up to 25 cm with creeping stems

***Taraxacum officinale*, dandelion**

COMPOSITAE

Common native perennial, height up to 35 cm

***Senecio vulgaris*, groundsel**

COMPOSITAE

Very common annual weed, height up to 40 cm with small yellow flower heads throughout the year

***Galium aparine*, goosegrass**

RUBIACEAE

Common native annual; climbing plant with stems up to 1 m with hooked fruits

***Urtica dioica*, nettle**

URTICACEAE

Native perennial, height up to 1.5 m; common on disturbed ground

Figure 13 Identification chart of flowering plants commonly found at the base of walls. Other species include:

Caryophyllaceae: *Stellaria media*, chickweed; *Sagina procumbens*, pearlwort
Compositae: *Artemisia vulgaris*, mugwort
Compositae (cont'd): *Sonchus arvensis*, sowthistle; *Achillea millefolium*, yarrow
Gramineae: *Hordeum murinum*, wall barley

Questions

(1) Explain the role of the following factors in controlling species distribution at each site:

   (a) nutrient status;
   (b) compacted soil;
   (c) slope;
   (d) width of crevice.

(2) Discuss which factor you consider to be dominant in controlling species distribution.
(3) Contrast the flora present at the base of the walls with that common to paving stones and walls (Exercise 10).
(4) Make a critical analysis of the methods employed in this exercise and devise an investigation for further analysis, e.g. to investigate the effect of people using the pavement.

Exercise 12: an investigation of the growth rate of lichens on gravestones

Background

A lichen is the result of a symbiotic relationship between an ascomycete fungus and an alga. The fungus forms the main structure of the plant, and its hyphae ramify throughout the substrate, providing attachment. The alga is green and therefore photosynthetic, and acts as the source of carbohydrate. Relying only on atmospheric precipitation for their mineral requirements, lichens are self-sufficient plants, and as such are pioneer colonisers of inhospitable habitats. Gravestones, while providing no obvious means of support for plant life, often possess a rich lichen flora in unpolluted areas (see Exercise 16). Any individual gravestone presents the opportunity to study a micro-environment, and a comparison between gravestones of various ages enables the growth rate of various species of lichen to be determined.

Care should be taken not to offend the recently bereaved, and other members of the church, so do obtain permission before commencing this exercise.

Aims

(a) To determine the growth rate of different species of lichen.
(b) To assess those factors affecting distribution and growth.

Materials

10 cm grid (100 squares) on acetate sheet; metre rule; scalpel or sharp implement; sample tubes; Universal indicator solution; magnetic compass.

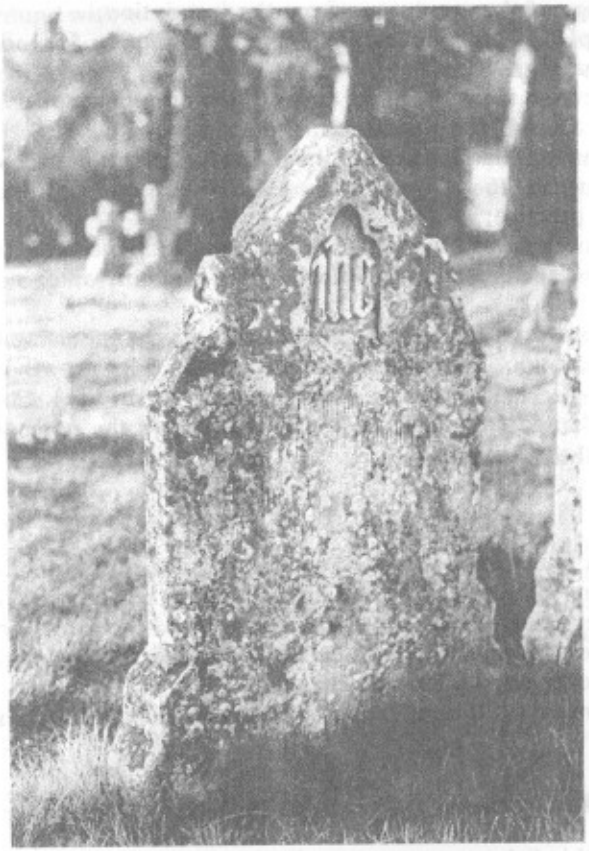


Figure 14 A gravestone with a rich lichen flora.

Time

This investigation is suitable for any time of the year: 3 h in the field; 30 min in the laboratory.

Method

An old cemetery is most suited to this exercise. Select between five and ten gravestones, representing as large an age-span as possible, but with clear inscriptions. Using the key provided, make sure that you can identify the common dominant lichens on the gravestones. Using the headstone, collect and record the following data from each gravestone:

(a) the age of the gravestone from the inscription;
(b) the pH of the gravestone: collect a sample for analysis in the laboratory;
(c) aspect and the percentage cover of the dominant species of lichen for both faces of the headstone;
(d) the average surface area of the individual plants of each of the dominant species: the 10-cm grid should enable you to do this quickly with a little practice;
(e) the location of any factors which may influence the growth rate of lichens such as bird droppings, damp patches, water runnels, etc.

In the laboratory calculate the pH of each gravestone using the Universal indicator solution. Tabulate the data collected. Plot growth curves for the dominant species of lichen (i.e. surface area versus age). Construct histograms to demonstrate the relationships between the percentage cover of lichens and the aspect.

Questions

(1) What is the annual rate of growth of each of the dominant species?
(2) Where there are significant differences in the pH value of the selected gravestones, explain how these influenced the growth rate.
(3) Suggest reasons for any local differences in the lichen growth around bird droppings, damp patches, etc.
(4) Comment on the influence of aspect on lichen distribution.

Key to the common gravestone lichens

1 Endolithic lichens penetrate the stone so that they are only evident from fruiting bodies, which after dispersal, leave black pits 1 mm in diameter in the stone. ***Verrucaria hochstetteri***

Crustose lichens form crusts which are so closely attached to the substrate that they are difficult to remove. **2**

Foliose lichens have a leaf-like appearance, usually lie flat on the stone, but are easily detached. **5**

2 Orange thallus. Thallus has a definite margin with radiating lobes. Fruiting bodies often present as orange discs in the centre of the thallus. ***Caloplaca aurantia*** or ***heppiana***

Yellow–green thallus present as powdery patches very closely applied to the stone. ***Lecidea lucida***

White thallus. **3**
Grey thallus. **4**

3 Thallus round with a cracked appearance in the centre but cracked with minute radiating folds at the margin. Black fruiting bodies are embedded in the thallus. ***Rhizocarpon umbilicatum***

Thallus round with radiating lines all over the upper surface. Fruiting bodies rare. ***Buellia canescens***

4 Thallus thick with a cracked appearance resembling crazy paving. Margins whitish. Spores produced in black discs. ***Lecanora calcarea***

(N.B. This species may be confused with *Rhizocarpon*.)

Thallus whitish-grey with a cracked appearance. Abundant flesh-coloured spore discs with thick rims giving this lichen the common name crab's eye. ***Ochrolechia parella***

5 Orange thallus. Thallus bright orange with cup-like discs. ***Xanthoria parietina*** or ***aureola***

Grey thallus. **6**

6 Thallus with powdery reproductive structures, the soralia. ***Physcia adscendens*** or ***Caesia***

Thallus marked with a network of coarse white lines or cracks. Mature plants have rod-like structures, the isidia, in the centre. ***Parmelia saxatilis***

Do not include Below

Exercise 13: an investigation of the woodlice population on stone walls

Background

Woodlice are common terrestial animals which tend to congregate in damp places during the day, as they are particularly susceptible to desiccation. Their usual habitats include dead tree-trunks, the underneath of stones, and the crevices of old walls. The diet of woodlice is mainly decaying organic matter, and they can be spotted at night grazing on the outside of old walls, particularly damp, shaded walls.

Aim

To estimate the number of woodlice in a population.

Materials

Torch; nail varnish or quick-drying paint; specimen dish or tray.