

# PICTORIAL TAXONOMIC KEYS: THEIR CONSTRUCTION AND USE FOR THE IDENTIFICATION OF FREELIVING MARINE NEMATODES

by

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## Résumé

Les Nématodes libres sont abondants et colonisent tous les habitats de la faune benthique. Ils sont généralement considérés comme particulièrement difficiles à identifier et de ce fait, ils ont reçu une attention irrégulière et inadéquate de la part des écologistes. Cependant, en pratique, la difficulté ne réside pas dans leur prétendue uniformité morphologique, qui est dans tous les cas erronée, mais elle est due à leur grande diversité et à une littérature taxonomique fragmentaire. Ce travail suggère que la disponibilité la plus largement répandue des clés illustrées faciliterait l'identification de cet important groupe d'organisme et susciterait un intérêt général pour lui. Les moyens de construire de telles clés sont discutés à partir d'exemples pris dans de récentes publications.

## Introduction

Freeliving marine nematodes are abundant and widespread inhabitants of marine sediments which, contrary to popular biological opinion, display a wide variety of form when observed through the microscope (Platt and Warwick, 1980). The myth of nematode morphological uniformity can easily be traced to the way in which nematodes are often introduced in biology courses. At least for the English-speaking world, Buchsbaum's (1951) book exemplifies the attitude: "Nematodes are so remarkably alike that a description of an ASCARIS roughly fits almost any other roundworm". But substituting 'Mammals', 'a RAT' and 'hairy chordate' in the appropriate places would produce a statement of equal veracity. Indeed, given that nematodes are intrinsically more simple organisms compared with mammals, their morphological heterogeneity is quite surprising.

Currently there are about 4 000 known species of freeliving marine nematodes: many more remain to be discovered. But in any one habitat, the ecologist can expect to encounter anything between 30-150 different species. This high species/area diversity coupled with the fragmentary and incomplete state of the taxonomic literature leads to practical difficulties in identification. The interested ecologist is faced with a large number of primary works of widely varying levels of scholarship, seldom having keys and, when they do, they are usually dichotomous verbal keys containing unfamiliar

jargon. These keys, whilst having certain uses as teaching aids or for the use of specialists already familiar with the group, rarely work for the non-specialist. The reason, in the case of marine nematodes, is primarily because many taxa are only poorly defined and

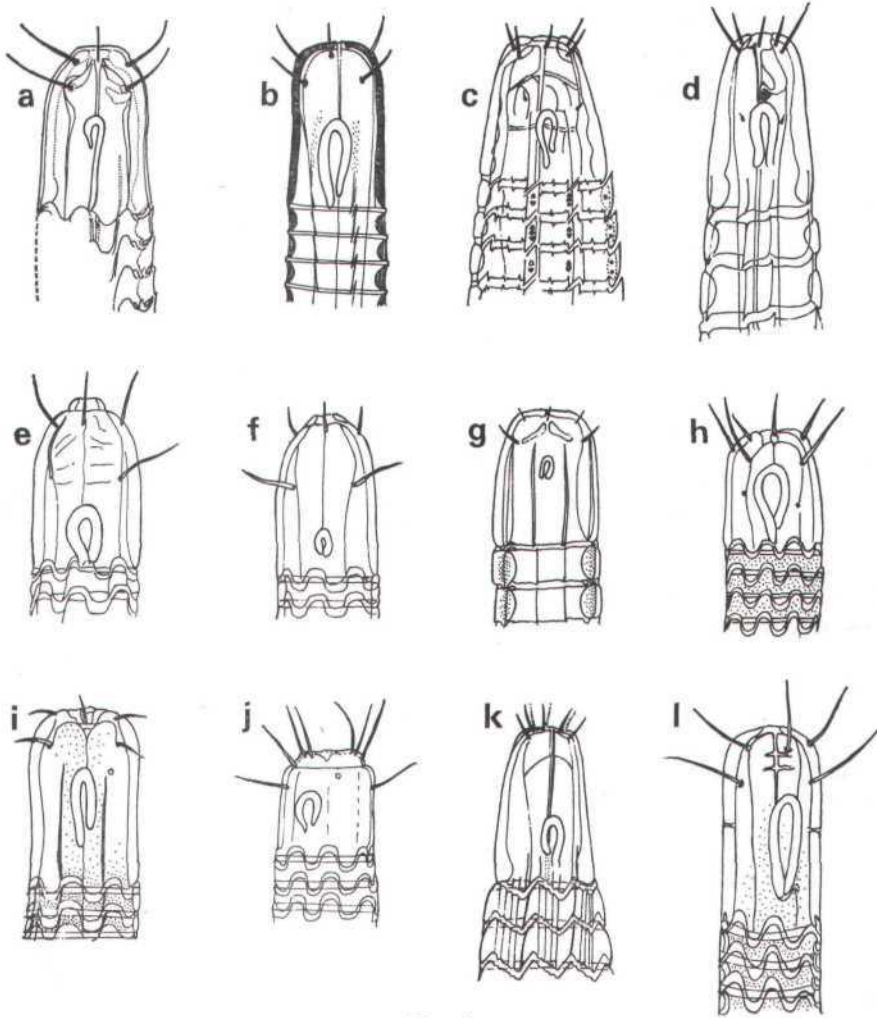


FIG. 1

Pictorial key to *Ceramonema* species (from Platt & Zhang, 1982).

few statements can be made for which there are no exceptions. Taxonomic diagnoses are often simply a list of several primitive characters which in combination appear to be unique.

So how can the identification of marine nematodes be made easier? One answer is to abandon the verbal key and to make more use of our most valuable taxonomic tool—the human eye. We are programmed to accept visual clues and can easily be trained to assimilate several characters simultaneously. This ability has long been recognised in other walks of life: aircraft recognition handbooks

use pictures and/or silhouettes and product recognition is the basis of advertising.

Neither is the use of pictorial keys new to biology. Roger Tory Peterson's (1934) field guide to North American birds—later repeated

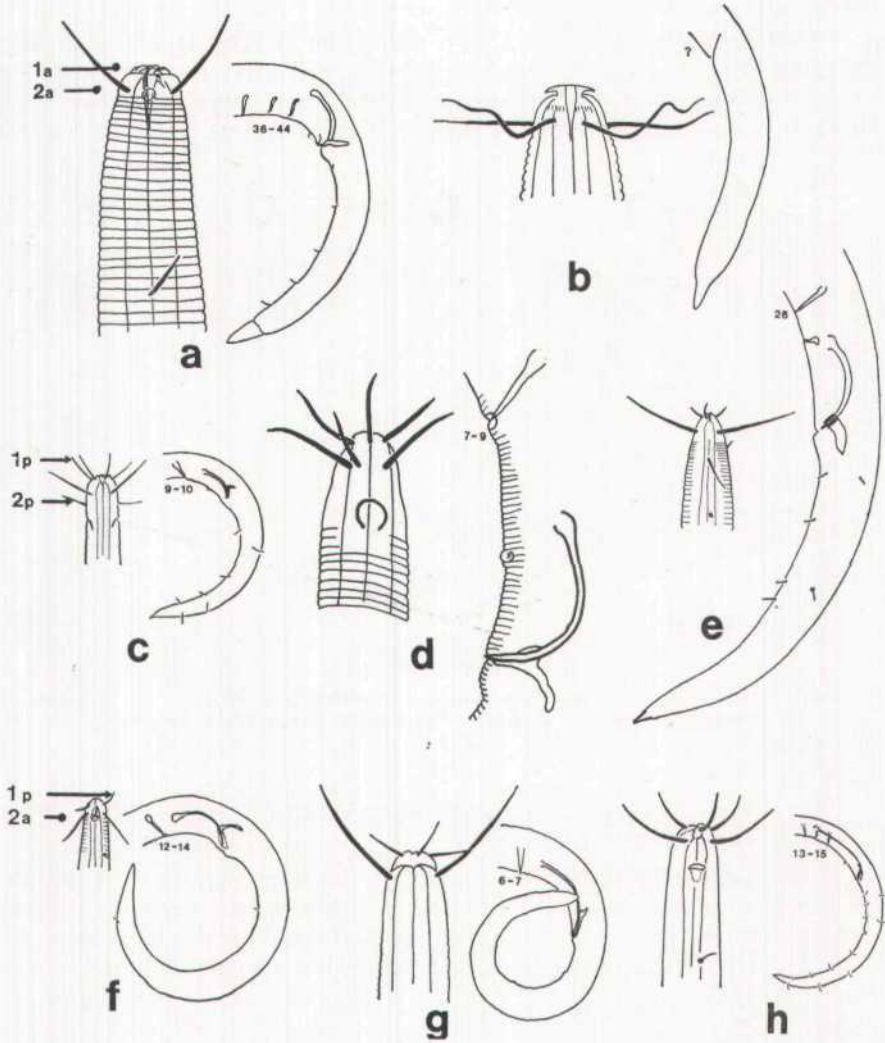


FIG. 2

Pictorial key to *Stephanolaimus* species (after Platt, 1983). Character 1: presence (p) or absence (a) of R2 sensilla. Character 2: presence or absence of lateral subcephalic setiform sensilla.

for European birds (Peterson *et al.* 1954) and both now classics—uses composite pictures of similar-looking birds and arrows draw attention to salient characters. Russel (1953) provided a totally pictorial key to some 80 species of British hydromedusae.

The challenge, then, is for marine nematologists likewise to distil their knowledge into a form which can, rapidly and with

little effort, be used by the non-specialist. A first beginning was made by Tarjan (1980) who provided an illustrated guide based on Andrassy's (1976) classification. Essentially, this is a dichotomous key with illustrated examples: I suspect that it is the compiled illustrations themselves which will prove most useful rather than the verbal key.

The next step is to move to a wholly or primarily pictorial key. In what follows, pictorial keys to species will first be discussed, i.e. keys to species of a particular genus, and then keys to higher taxa. In each case, examples will be provided from recent published work.

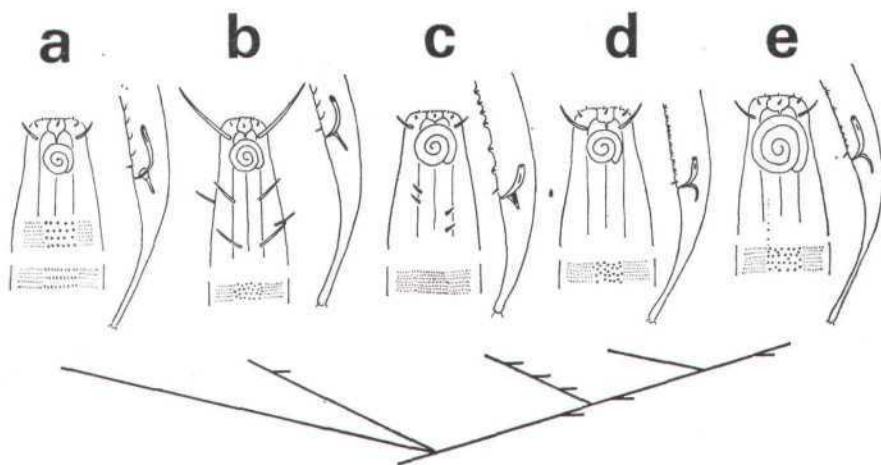


FIG. 3

Pictorial cladistic key to the five subsets of *Sabatieria* species: a, *praedatrix*; b, *armata*; c, *pulchra*; d, *celtica*; e, *ornata*. From Platt (in press).

### Construction of pictorial keys

#### 1. Species keys

Before constructing a key, a vital preliminary step is to eliminate all those taxa which would otherwise confuse the issue. In most groups there is always a certain amount of deadwood which must be cleared. This stage could be called validation of operational taxonomic units (OTUs).

##### a. Validation of OTUs

Pictorial keys were devised in the course of revising the common genus *Sabatieria* (Platt, in press). Of the 73 original species, 6 were already designated as dubious, and 14 were added to this number, many on the grounds of being described from juveniles or females only, some for being poorly illustrated, often for both these reasons. For example, *S. antarctica* of Cobb (1930) is very poorly figured and anyone collecting from the area could never be sure beyond reasonable doubt that they had encountered the same species.

Seven other species were designated *species inquirenda* on the grounds that although information was lacking, the species may well be recognisable if collected from the type locality. For example,

*S. sarcina* of Vitiello (1976) was originally described as having no supplements. Rather than creating a separate taxon for 'Sabatieria species without supplements', which probably should not then be *Sabatieria* species at all, it seemed preferable to wait for further information. However, all the *species inquirenda* were figured separately and morphometric data given to facilitate later incorporation into the key.

If the key is part of a major revision, then species may often be transferred into or out of a taxon. In the case of *Sabatieria*, the net result of all this taxonomic adjustment was a reduction of the original 73 species to just 36 valid species.

#### b. Arrangement of OTUs

The next job is to make drawings of each of the species. Since the head and tail region of males normally contain most if not all of the species-specific characters, in most cases this will be sufficient. Original drawings should be made wherever possible but some copying from the literature is inevitable, with reinterpretation where necessary to obtain a degree of uniformity in style. The drawings do not need to be to the same scale, but an indication of scale should be given where possible.

The next stage depends on the number of species to be keyed. Up to about 12, the number which can conveniently fit on one page, the species can be arranged in any convenient order. It is often possible simply to arrange them in alphabetical order, e.g. *Ceramone-ma* (Fig. 1: Platt & Zhang, 1982), since it will not be too time consuming to check each drawing.

However, it is more satisfying to have some ordering, as in the case of *Stephanolaimus* (Fig. 2: Platt, 1983) where two characters are used to divide the species into three horizontal rows.

Anything over a dozen species should be broken into subsets, preferably not on continuously variable characters such as body length. Presence/absence characters would be ideal but tend to be rare at the species level—they will usually have been used as generic characters. In the case of *Sabatieria* (Fig. 3), the species were split into 5 groups based on a cladistic analysis, each group being designated by a representative species. Each subset was then ordered in the most practical way. For example, species of the *armata*-group, those with elongated R3 and cervical setae, were divided into rows on supplement number (Fig. 4).

## 2. Supra-specific keys

The problem with creating a single picture to represent a taxon above the species level is that each must be some kind of amalgamation. In practice, this does not prove too much of a problem at the genus level. In the generic key produced for a synopsis of the British fauna (Platt and Warwick, 1983), where a character was variable, the representation was biased towards the more commonly reported species. If the taxonomy is correct, then no matter how different an actual species looks compared with the genus caricature, it *should* still look more like a member of that genus than any other.

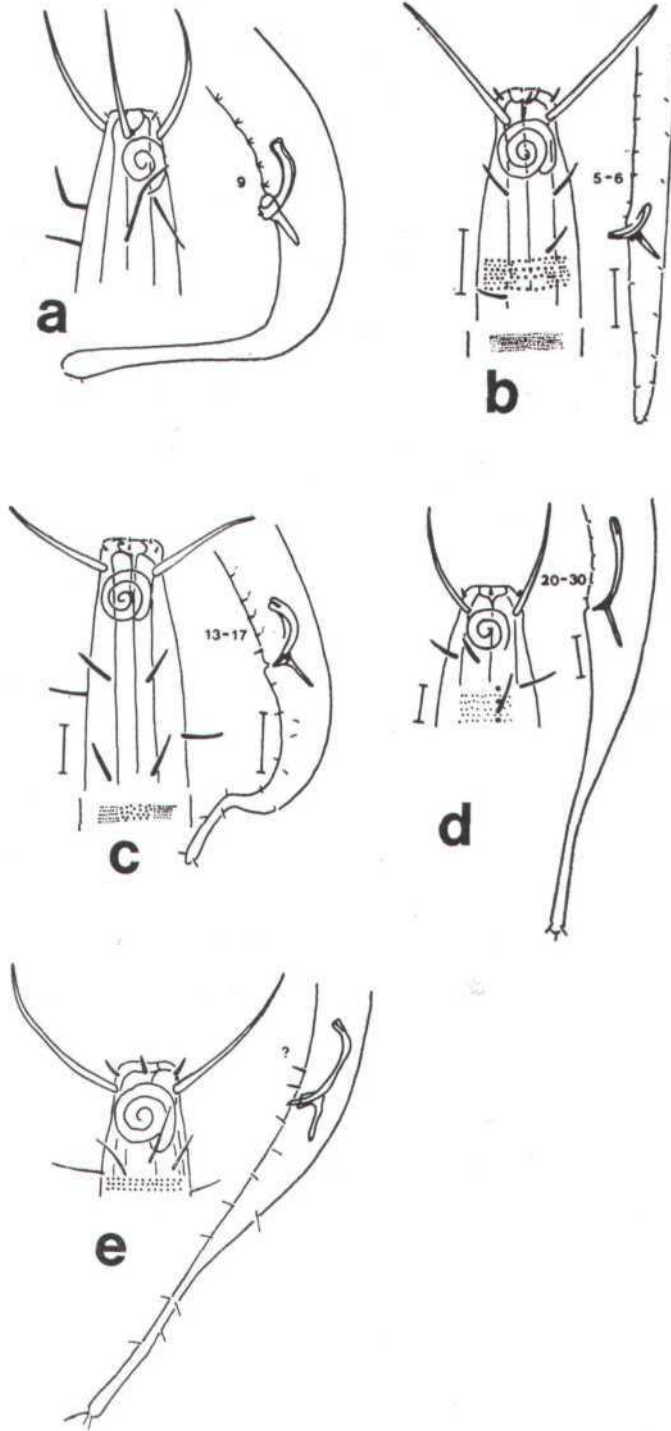


FIG. 4

Pictorial key to *Sabatieria* species of the *armata*-group: a, *S. armata*; b, *S. longispinosa*; c, *S. elongata*; d, *S. migrans*; e, *S. supplicans*. From Platt (in press).

After validation of the OTUs, the resultant 270 genera were arranged into 23 plates of similar-looking forms, not necessarily conforming to any accepted classification although this was often reflected. On each plate (e.g. Fig. 5), the more common genera were

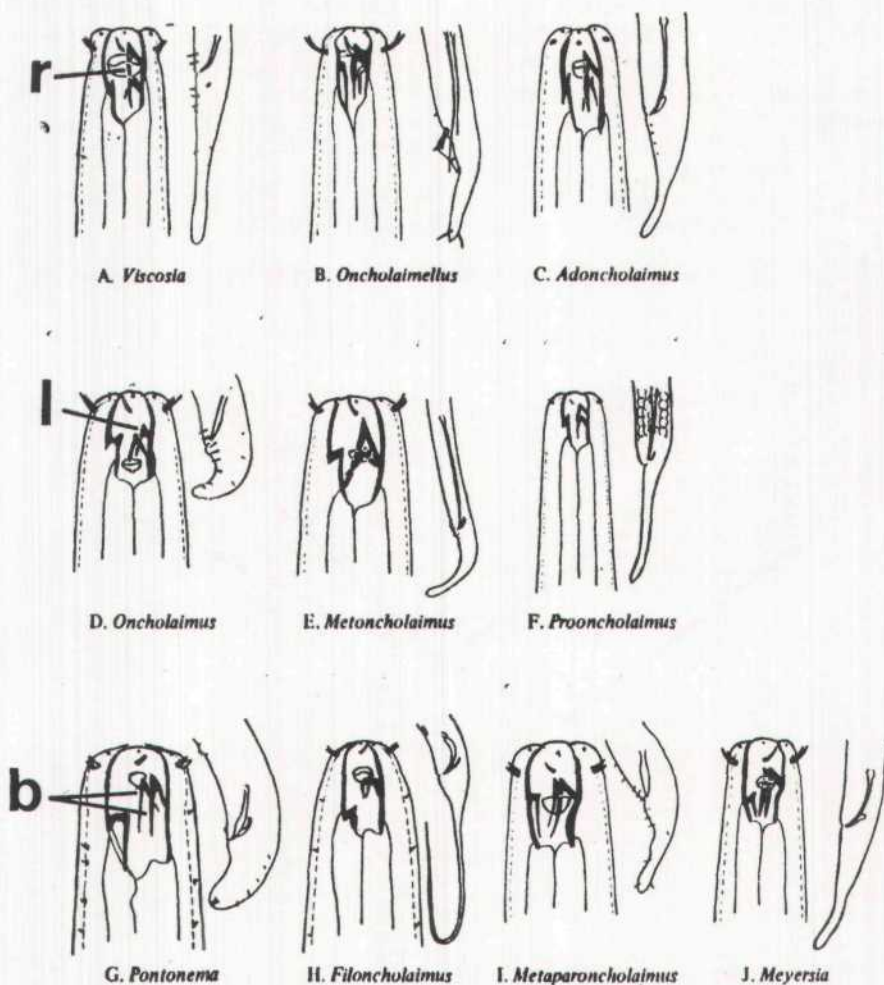


FIG. 5

Plate of enoplid genera from the pictorial key to world genera (after Platt & Warwick, 1983). Characters: r = right subventral tooth longest; l = left subventral tooth longest; b = both subventral teeth long.

arranged in the left-hand column. So by scanning down only those on the left, eventually one will be found which resembles the specimen in question. If the fit is still not satisfactory, then the genera further to the right can be checked. It was found useful in this case to supplement the pictures with some words, either drawing particular attention to a character or mentioning characters not actually contained in the pictures, such as gonad number. The key was tested with several non-specialists and found to have a high level of success.

If only a few genera are being dealt with, they are much easier to arrange. In the case of a key to the genera of the subfamily Dorylaimopsinae (Fig. 6), it proved useful to place the pictures on a cladogram.

Pictorial keys to taxa above the generic level will prove more of a challenge: they are still in the process of being developed. However, in purely practical terms, since keys going straight to genus appear to work, pictorial keys for supra-generic taxa may be unnecessary.

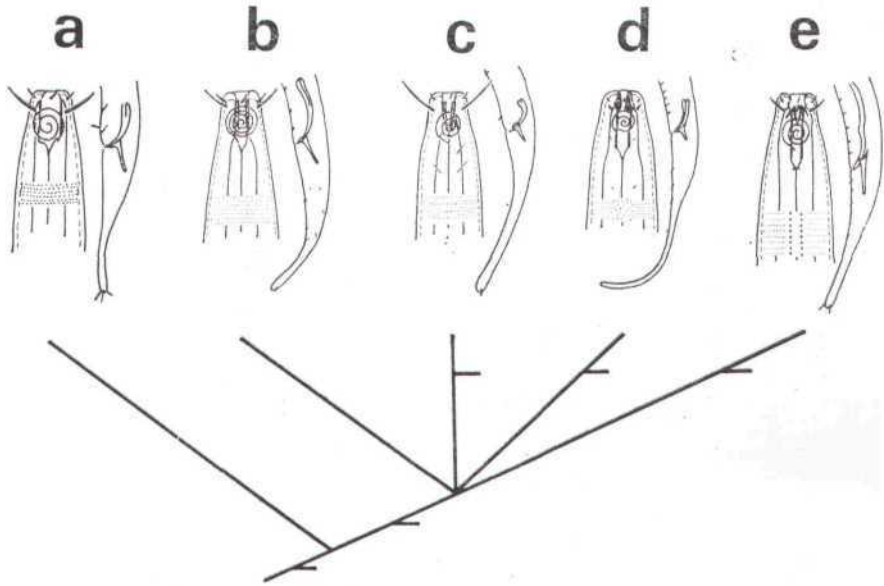


FIG. 6

Pictorial eladistic key to genera of the subfamily Dorylaimopsinae: a, *Metasabatieria*; b, *Vasostoma*; c, *Paramesonchium*; d, *Hopperia*; e, *Dorylaimopsis*. From Platt (in press).

### Discussion

The use of pictorial keys in practice should not be to identify a specimen but to say what a specimen is not. In other words, they are best used as a process of elimination. Eventually, one may end up with a short-list, when more detailed descriptions of the taxa in question should be consulted. Original descriptions, or good redescriptions, should in any case be checked where a putative identification based on pictorial keys is to be published: a precaution which applies equally well, of course, to verbal keys. The watchword in the design of pictorial keys is flexibility. The subject should dictate the format and the ultimate test is simply whether or not it works.

It is to be expected that an increase in both the number and availability of practical pictorial keys will enable the pleasures and benefits of working with such a little-understood group as marine



nematodes to be spread more widely among the biological community. Thereby, this important group of organisms might begin to receive the detailed attention so often called for.

### Summary

Freeliving nematodes, abundant and ubiquitous inhabitants of marine benthic habitats, are generally considered to be notoriously difficult to identify. This belief has resulted in their receiving irregular and inadequate attention from ecologists. However, in practice the difficulty lies not in their supposed morphological uniformity, which is in any case erroneous, but in their great diversity coupled with a fragmentary taxonomic literature. It is suggested that the more widespread availability of pictorial keys would facilitate identification of, and generate interest in, this important group of organisms. The means of constructing such keys is discussed using examples from recent publications.

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