

## MICROSCOPICAL EXPLORATION FOUR

### **ANOTHER EXCURSION INTO THE REALM WHERE SCIENCE BECOMES ART**

**James R Stewart Cumbria UK.**

#### INTRODUCTION

For the purposes of this excursion I have decided to take a more quantitative approach than the largely qualitative one that I took in my previous microscopical explorations. To that end I will provide a more in depth description of how the homemade components used are constructed and installed.

Images to illustrate their construction and to demonstrate their effects will also be included.

I will also explain in more detail the reasons for the choice of test solution and its preparation and subsequent use.

The aim of this exploration/excursion remains the creation of pictures worthy of the designation of 'art', albeit 'abstract art'

#### THE SCIENCE

#### THE EQUIPMENT

The microscope used in this investigation is an APEX PRACTITIONER fitted with a BRUNEL EYECAM PLUS digital eyepiece camera and a homemade polariser/analyser combo.



**Detail showing homemade polarising filter and waveplate in position on Apex Practitioner Microscope**

## **The Polarising Filter Assembly**

The polarising filter assembly was constructed using an old filter holder which came with my Vickers M10A microscope, which I have owned and used for several decades. The polarising filter disc itself was cut from Linear Polarising Film bought, from the Internet, as a 100mm x 100mm x 0.8mm sheet. A small index mark, to help with their alignment, was applied to the filter holder, the filter and the microscope sub-stage illuminator using a correction fluid pen (You know the stuff, Tippex).



The polarising filter assembly was positioned immediately on top of the microscope sub-stage LED lighting unit (see picture above).

## **The Analysing Filter Assembly**

The analysing filter assembly was constructed using the tube from an old microscope eyepiece with all the glass elements and metal stops removed. A second disc of polarising film was cut to size and inserted in place of the lower glass lens in the eyepiece tube.

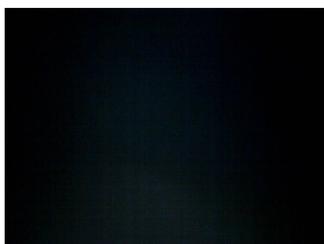


**Analysing Filter Assembly**

The analysing filter assembly was positioned in the microscope body tube above the objective lens turret.

THE POLARISING AND ANALYSING FILTER ASSEMBLIES WERE ARRANGED IN CROSSED CONFIGURATION GIVING RISE TO MAXIMUM EXTINCTION AND THUS TO A DARK FIELD OF VIEW.

THIS ARRANGEMENT WAS NOT CHANGED FOR THE DURATION OF THIS EXPLORATION.



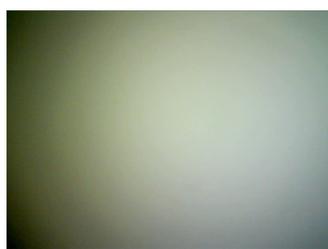
**Extinction field of view**

### THE HOMEMADE WAVEPLATES

A series of four waveplates was constructed by the application of branded sticky tape (Sellotape) to four clean glass microscope slides, applying 1,2,3 and 4 layers respectively in **longitudinal (L)** configuration.

A second series of four waveplates was constructed by the application of branded sticky tape (Sellotape) to four clean glass microscope slides, applying 1,2,3 and 4 layers respectively in **transverse (T)** configuration.

Each of the waveplates is named, as follows, according to the number of layers of sticky tape (**1-4**), their configuration (**L or T**) and the background colour that is generated, as shown below, when it is interposed in the light path immediately above the microscope sub-stage condenser (see picture above). The apparent variation in intensity across the field of view is due to the characteristics of the camera sensor.



Waveplate 1TGrey



Waveplate 1LGrey



Waveplate 2TCyan



Waveplate 2LCyan



Waveplate 3TMagenta



Waveplate 3LMagenta



Waveplate 4TGreen



Waveplate 4TGreen

### THE REAGENTS

#### THE TEST SOLUTION

My previous explorations utilised pharmaceuticals comprising **mixtures of various organic chemicals** and involved co-crystallization of the components of those mixtures from solution in **acetone free nail polish remover (ethyl ethanoate)**.

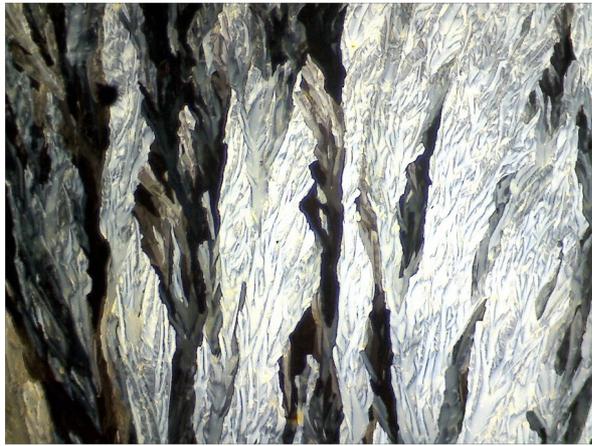
In Microscopical Exploration Four I will use the same solvent but will dissolve only one organic solute, **N-(4-hydroxyphenyl)acetamide**, otherwise known as Paracetamol (UK) or Acetaminophen (USA).

To make the test solution the contents of two 500milligram Paracetamol capsules were emptied into a small lidded glass jar and 20 millilitres of acetone free nail polish remover were added. The jar was sealed with its lid and shaken to mix the contents which were then allowed to dissolve and equilibrate for several hours. This yielded a clear solution which did not require filtration. Thus the concentration of this solution was calculated to be 50 milligrams per millilitre (mg/ml) with respect to paracetamol/acetaminophen.

#### THE SPECIMEN SLIDES

A specimen slide was prepared by applying 10 drops (approximately 0.5 millilitres) of the test solution to a clean glass microscope slide and allowing the solvent to evaporate at an ambient room temperature of 21°C

The crystals thus formed on the specimen slide were then viewed using the x4 objective with each of the wave plates, in turn, positioned as shown above, and the images below were captured to illustrate the effect of each waveplate.



No waveplate



Waveplate 1LGrey



Waveplate 1TGrey



Waveplate 2LCyan



Waveplate 2TCyan



Waveplate 3LMagenta



Waveplate 3TMagenta



Waveplate 4LGreen



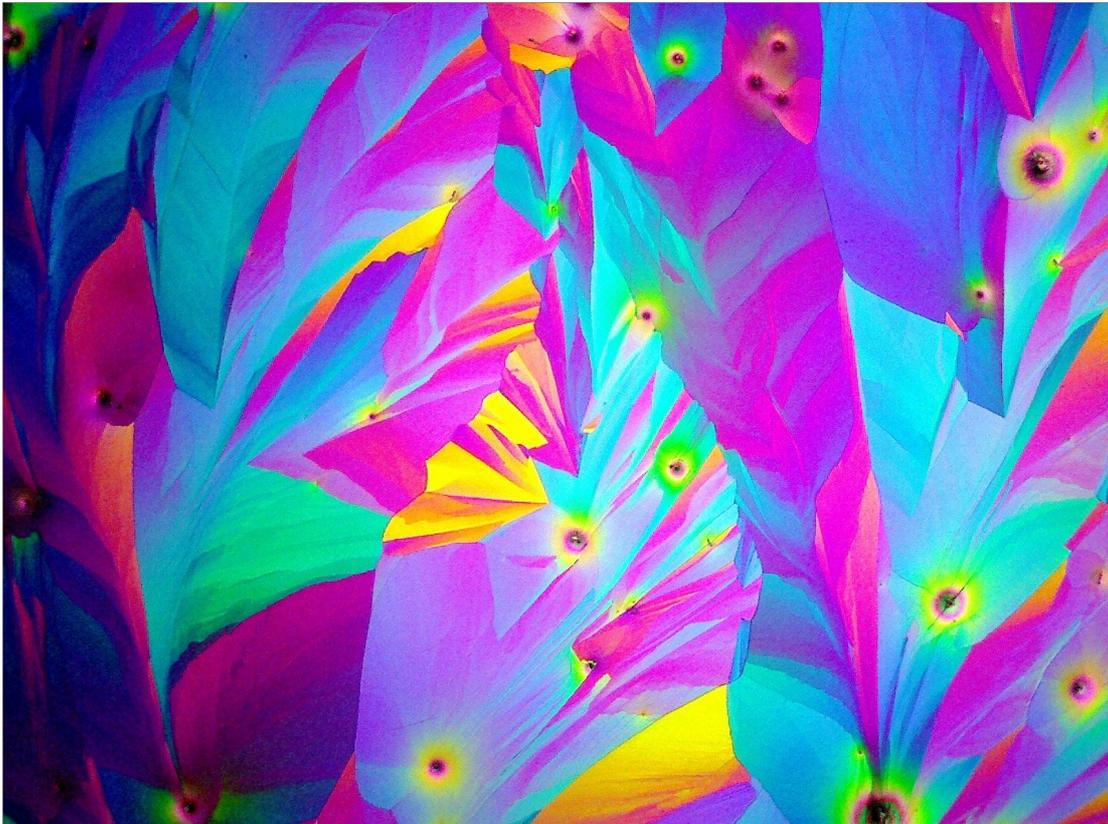
Waveplate 4TGreen

Further specimen slides were prepared, as above, and different areas of each were viewed with one or other, or none, of the various waveplates in position. The pictures below were captured using MycoCam 5.0 image capture software and each is the result of the focus-stacking of between three and five images.

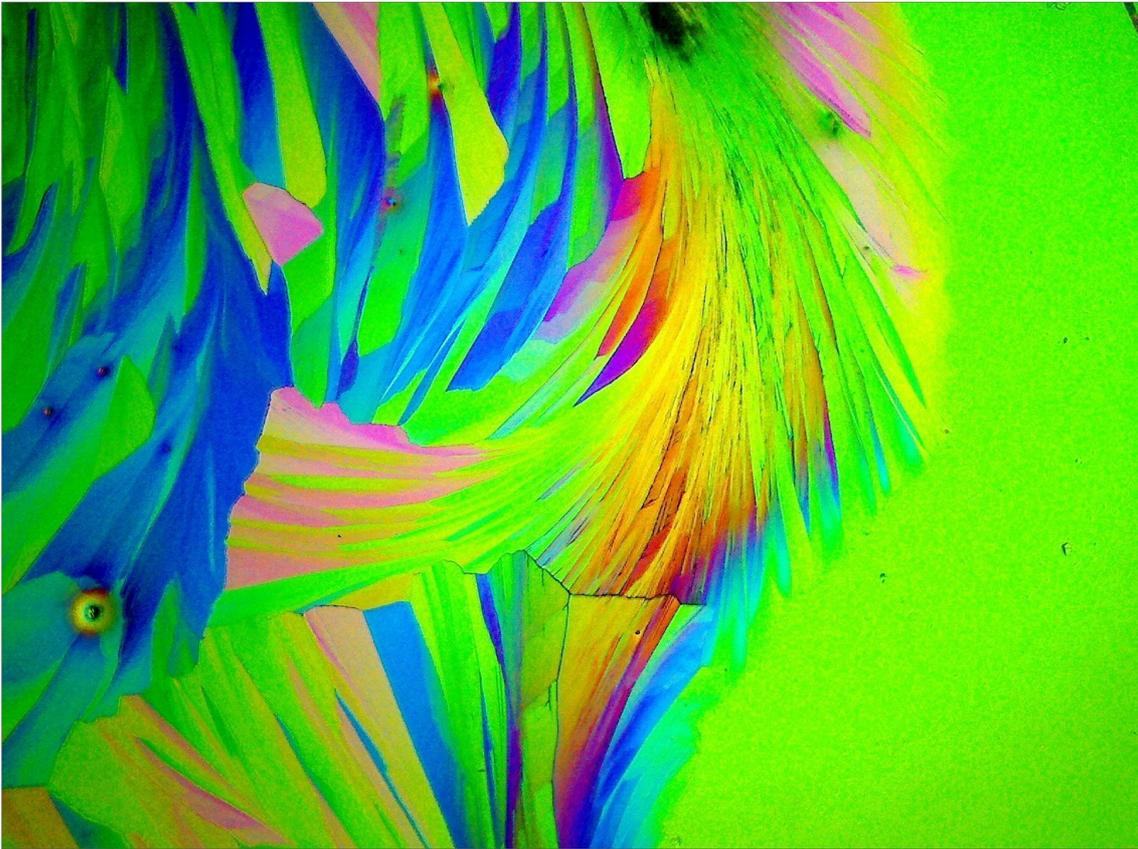
## **THE ART**



**Picture 1**



**Picture 2**



**Picture 3**



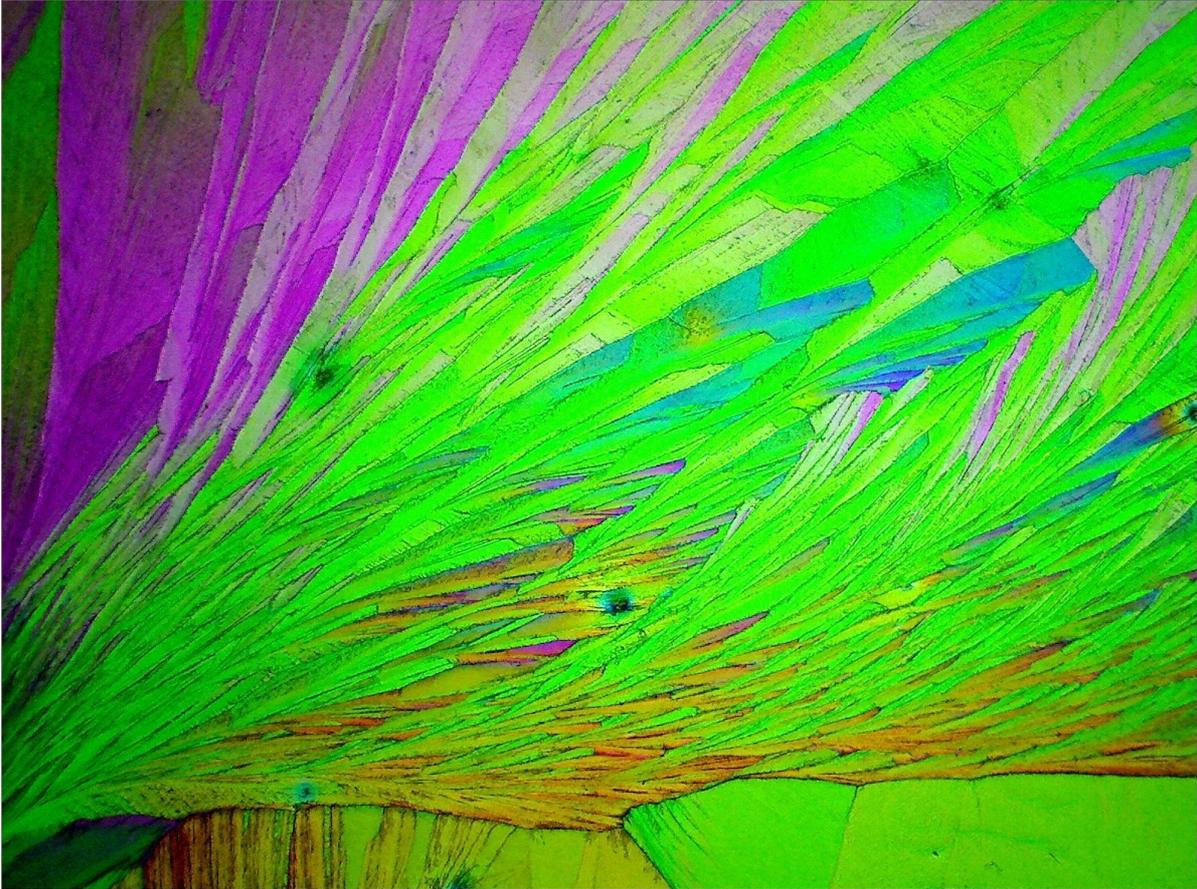
**Picture 4**



**Picture 5**



**Picture 6**



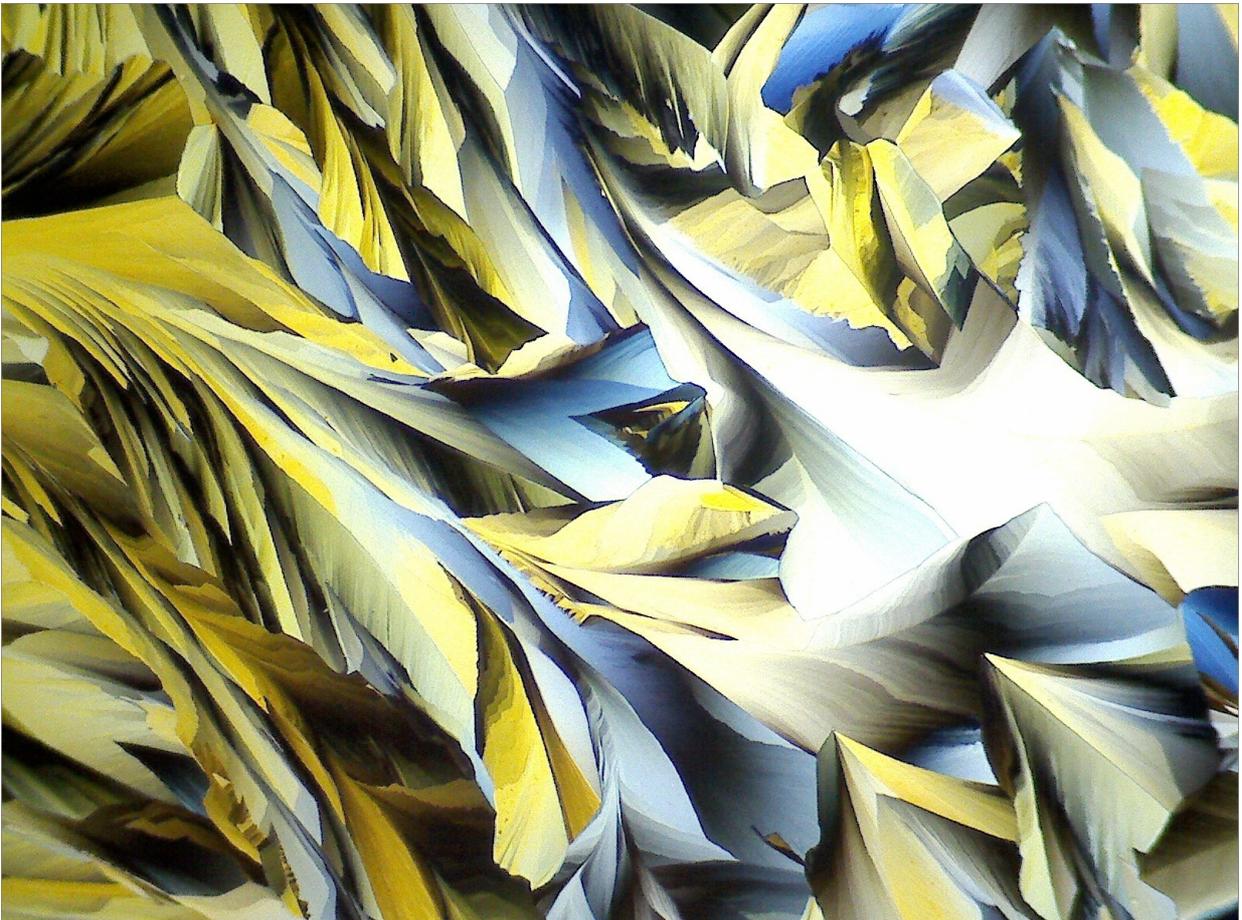
**Picture 7**



**Picture 8**



**Picture 9**



**Picture 10**



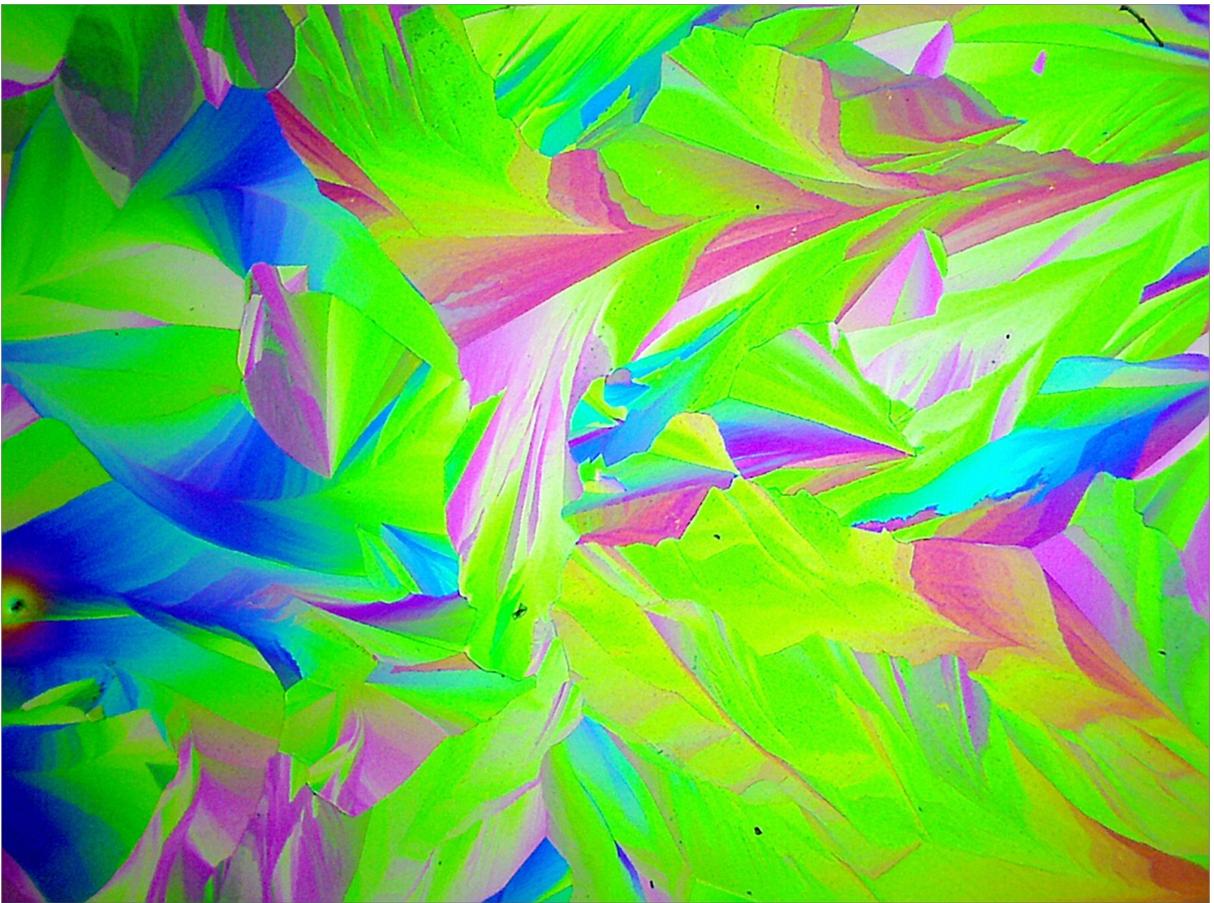
**Picture 11**



**Picture 12**



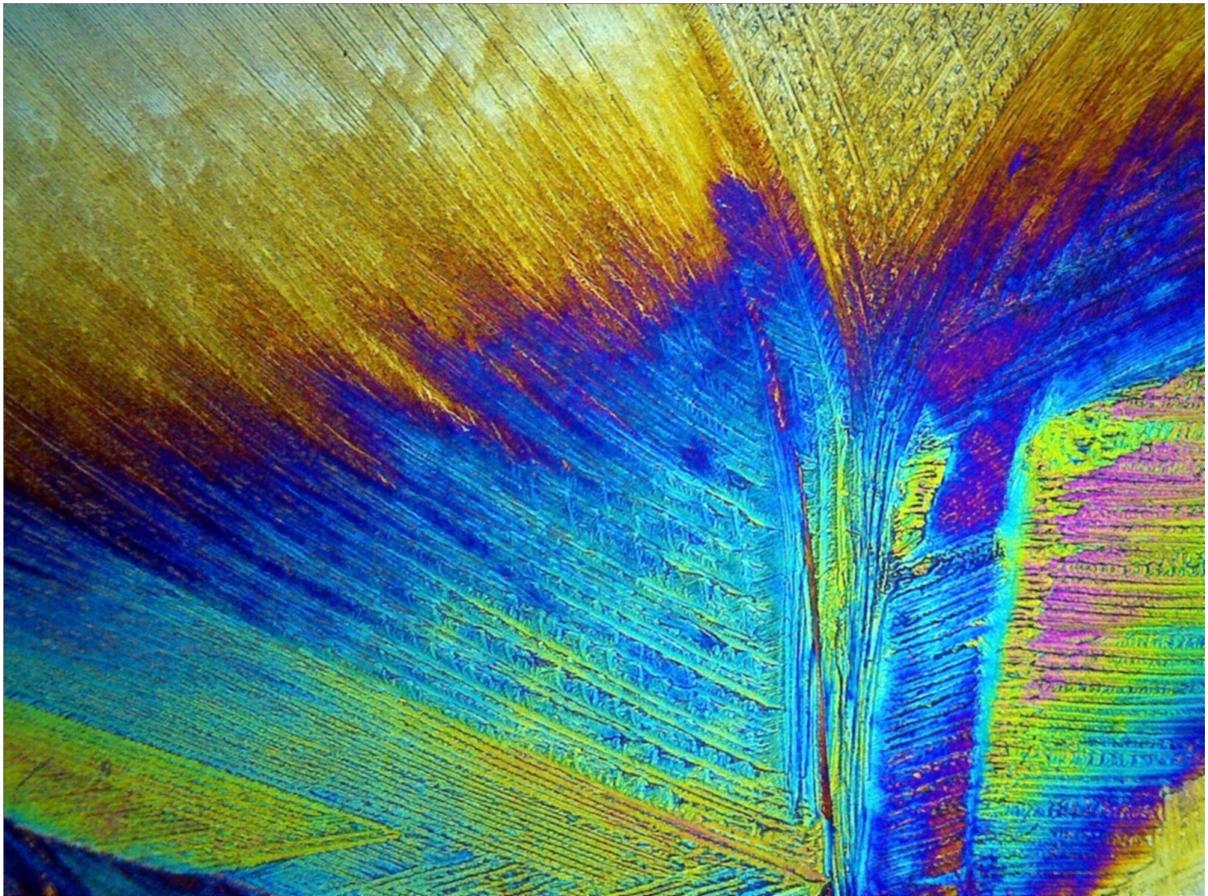
**Picture 13**



**Picture 14**



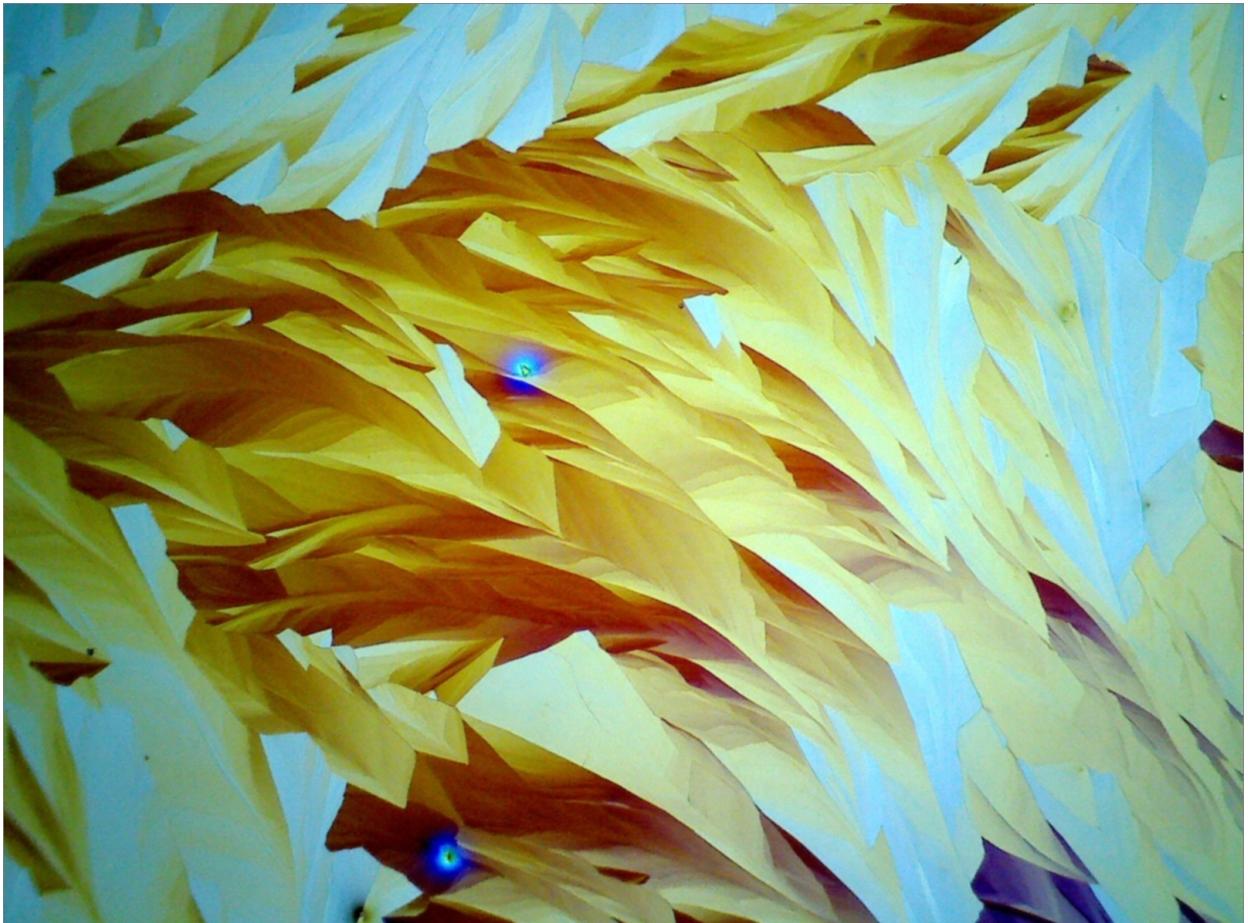
**Picture 15**



**Picture 16**



**Picture 17**



**Picture 18**



**Picture 19**



**Picture 20**

## **IN CONCLUSION**

The pictures above illustrate some of the many and varied patterns produced by the crystallisation of this one relatively simple solid organic compound from solution in an even simpler organic solvent.

The use of the eight sticky tape waveplates demonstrates the strikingly colourful effects that these simply constructed devices can have on images of easily obtainable materials when viewed under polarised light.

**Interpret these abstract pictures as you will, but as we say here in Cumbria:**

**'Ave a go yersel'!**

**stewartr178ATyahooDOTcoDOTuk**

**James Stewart**

Published in the September 2020 issue of *Micscape* magazine.

[www.micscape.org](http://www.micscape.org)