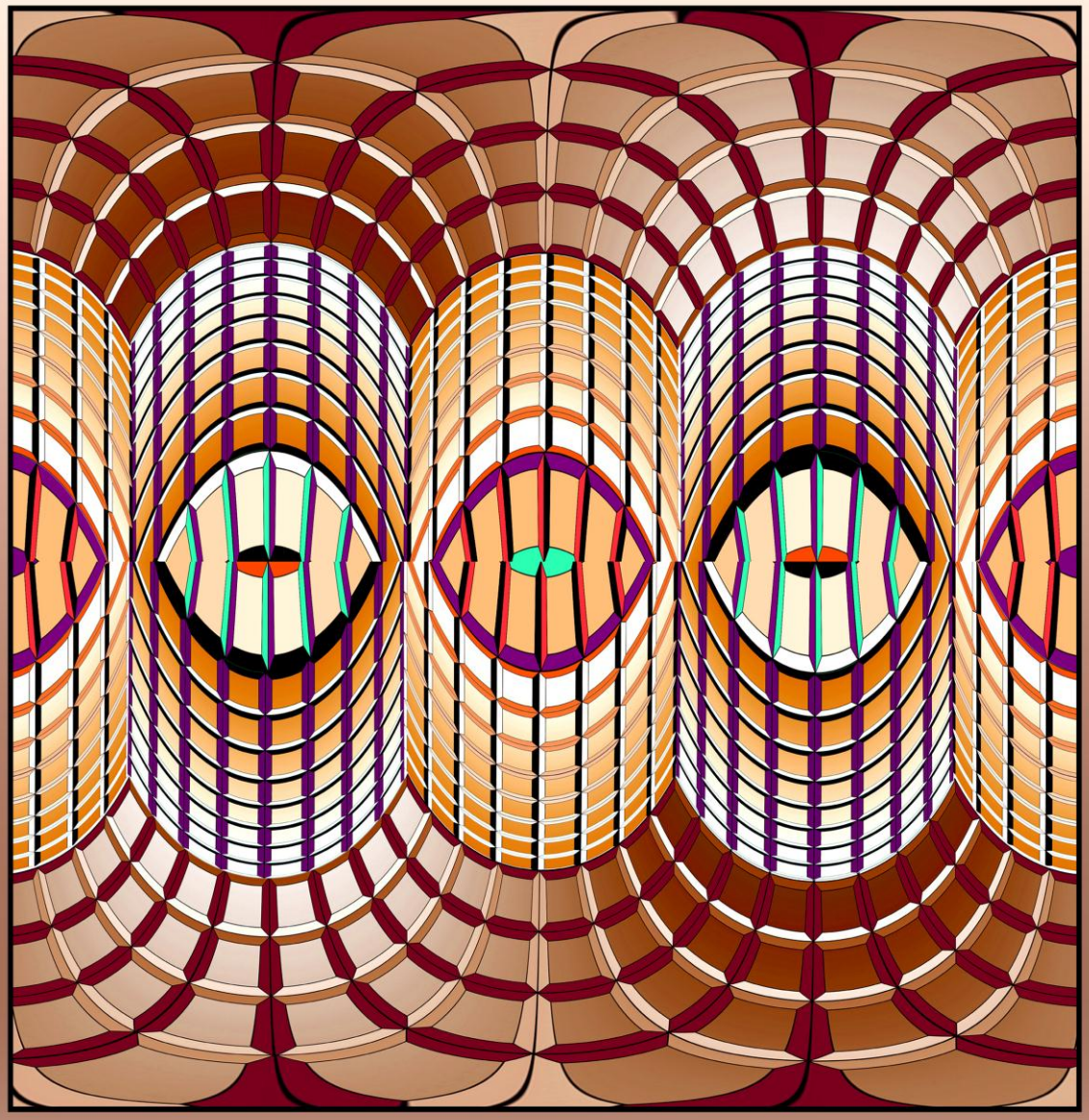
L'ARABESQUE MODERNE

TOME 25 : la géométrie des arabesques



Par Louis ARNAUD

Titre des livres de l'auteur :

Dessin de l'arabesque : 4 tomes.
L'arabesque en Espagne : 2 tomes.
L'arabesque au Maroc : 4 tomes.
L'arabesque seldjoukide : 2 tomes.
L'arabesque dans l'empire ottoman : 2 tomes
L'arabesque en Asie Centrale : 2 tomes.
L'arabesque au Rajasthan : 3 tomes.
L'arabesque en Iran : 2 tomes.
Technique de l'arabesque : 2 tomes.
Arabesques traditionnelles : 1 tome.
Arabesques modernes : 1 tome.
Pavages d'arabesques : 1 tome.
Construction d'arabesques : 1 tome.

Pour en savoir un peu plus sur l'auteur :
http://www.arabesquesgeometriques.fr/bibli1/auteur.pdf

Consultez le site de l'auteur pour avoir accès à plus de 2000 photos haute résolution, près de 200 diaporamas ou vidéos et près de 200 constructions guidées, le tout agrémenté d'une musique orientale originale.
www.arabesquesgeometriques.fr/

Tous les DESSINS et PHOTOS sont de l'auteur.

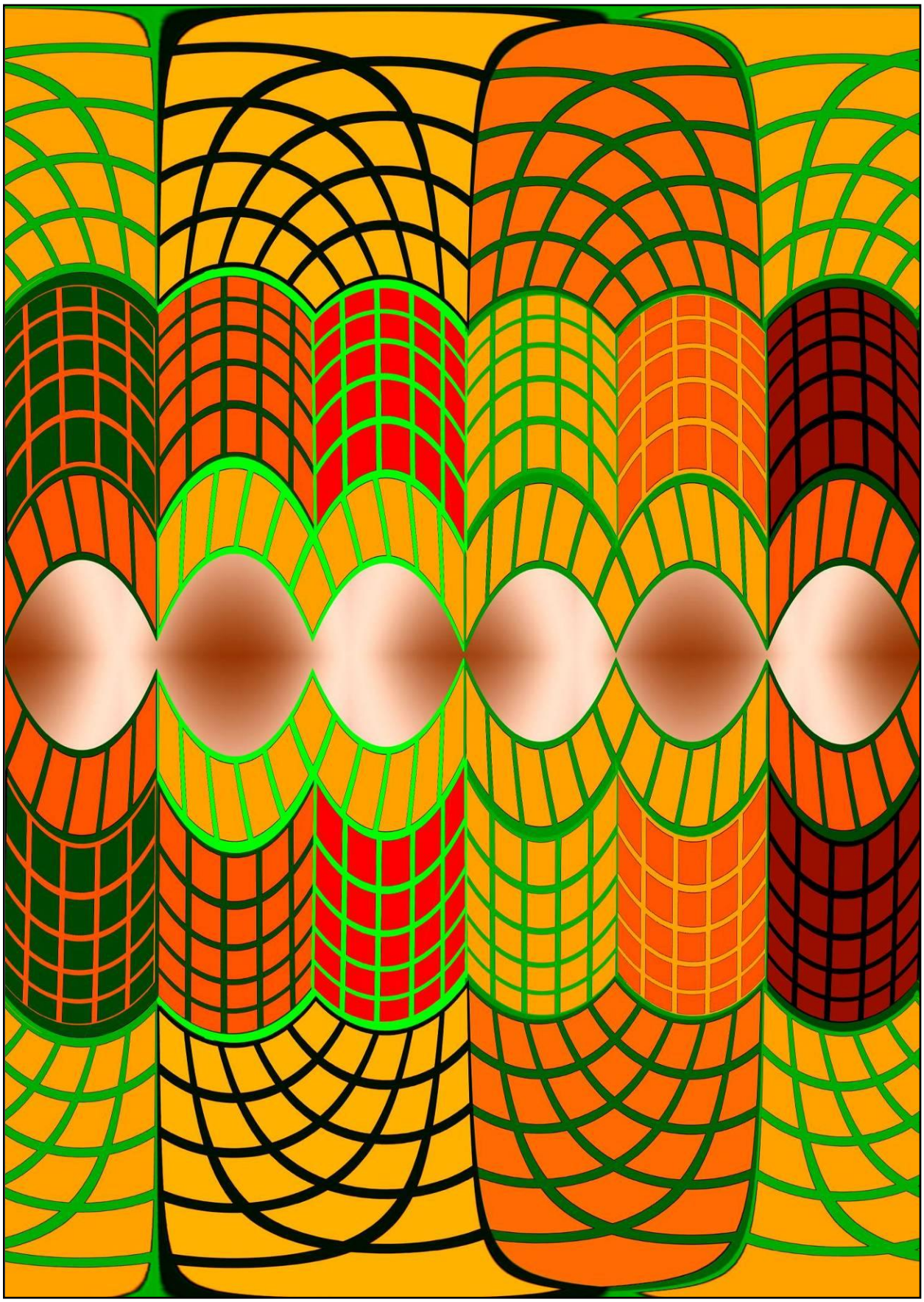
Arabesques modernes

TOME 25 : la géométrie des arabesques.

Voici une autre vision artistique beaucoup plus moderne s'éloignant des conceptions originelles et traditionnelles, avec une utilisation des capacités de l'ordinateur.

Par Louis Arnaud

PHOTOTHEQUE



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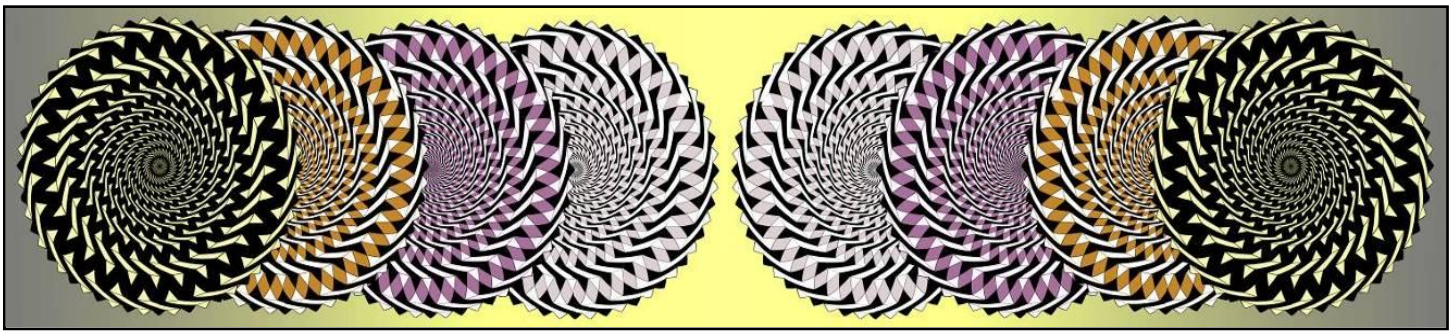
. ARABESQUES MODERNES. 71



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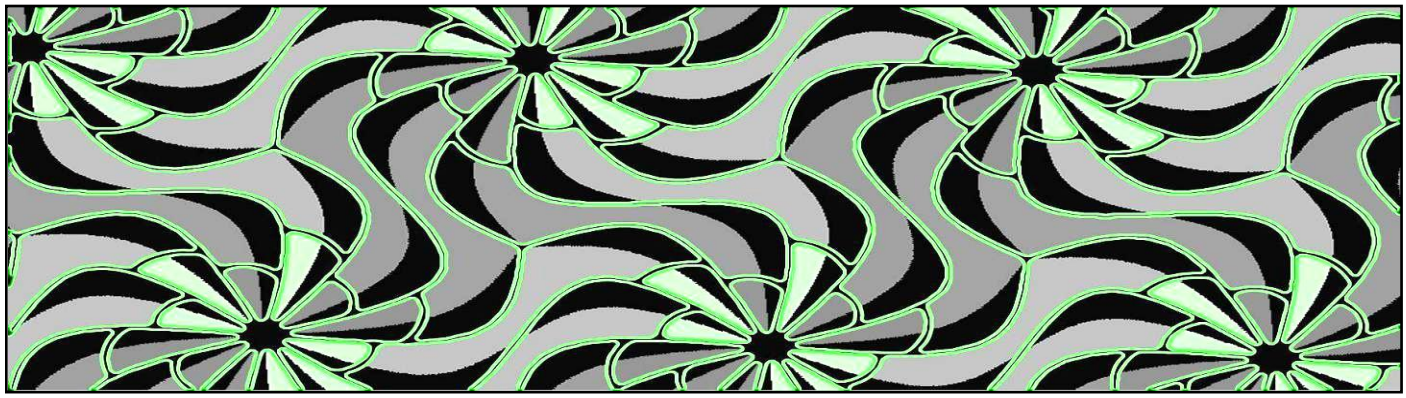
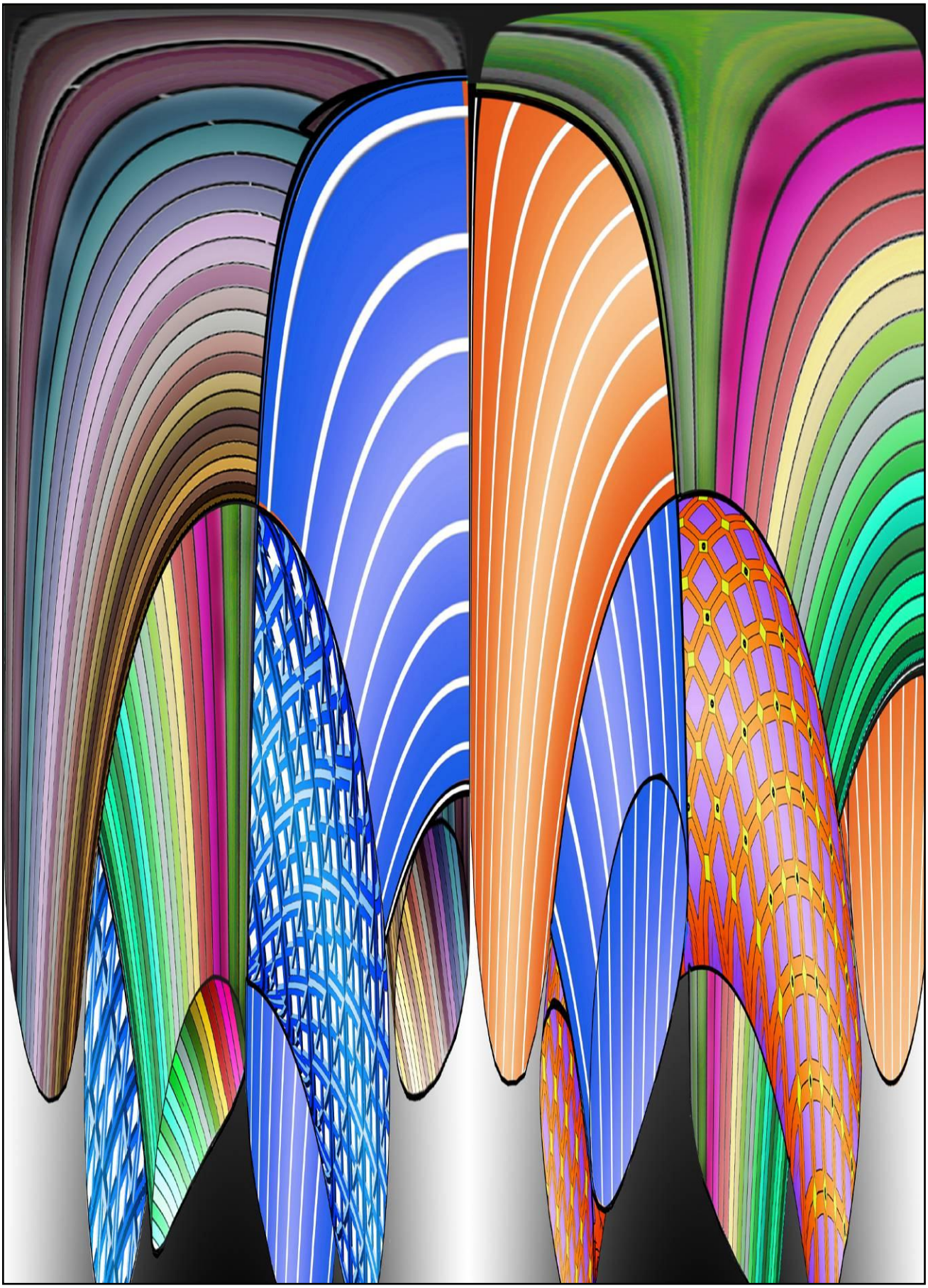
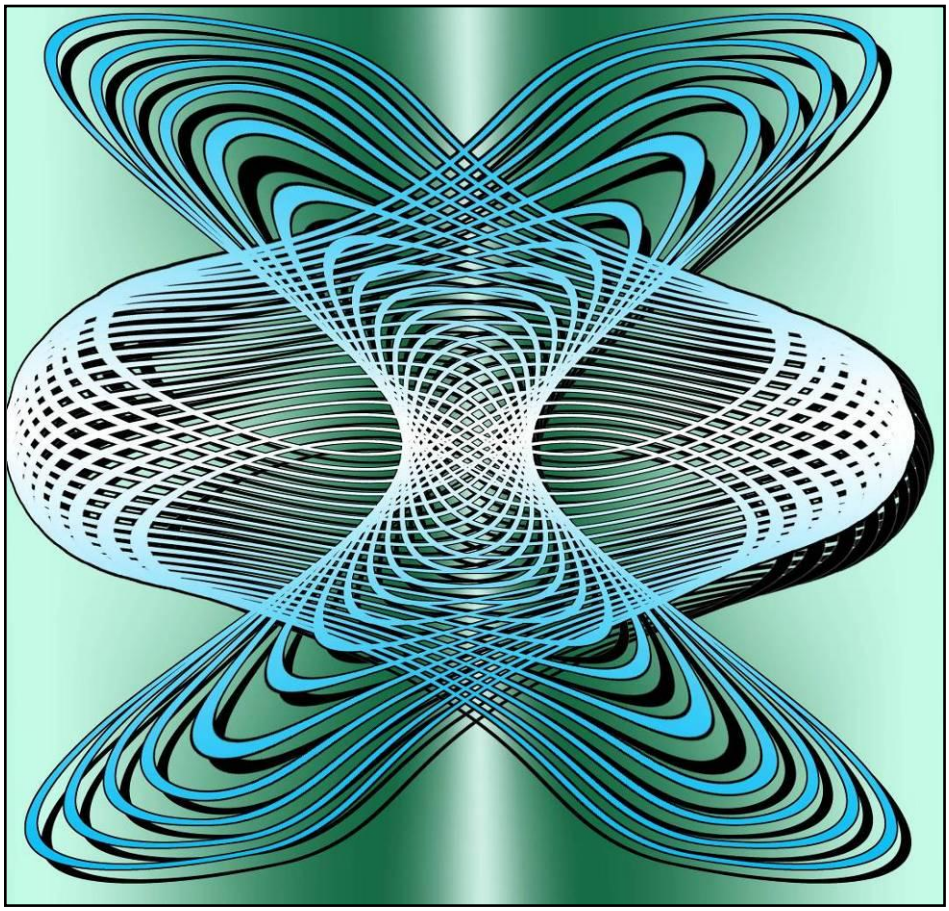
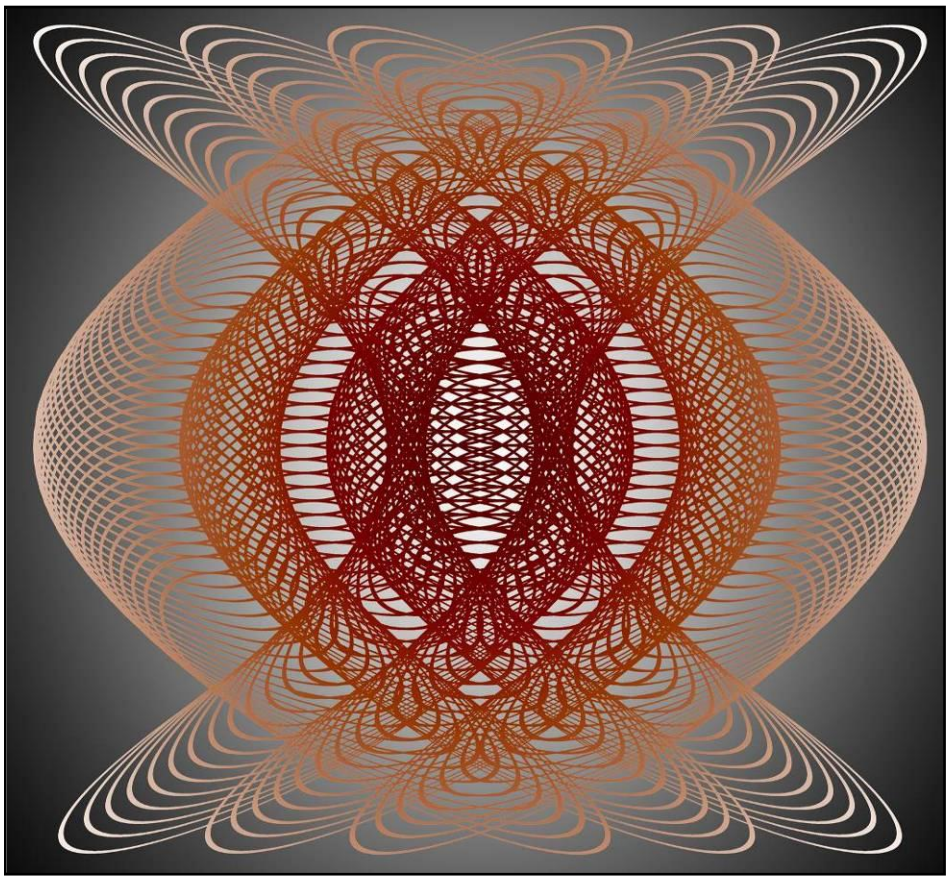
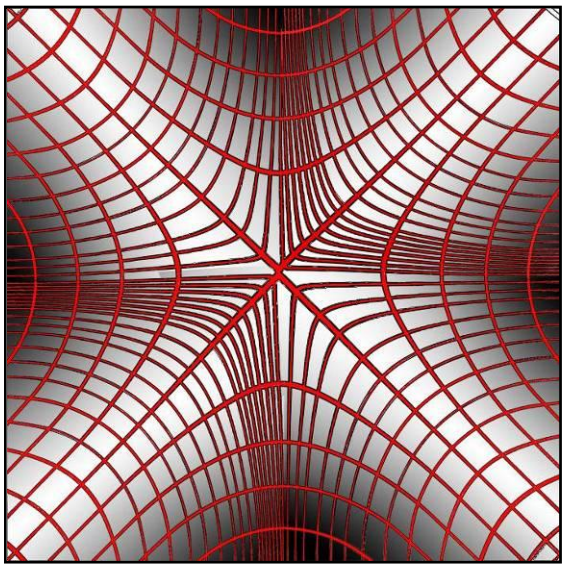
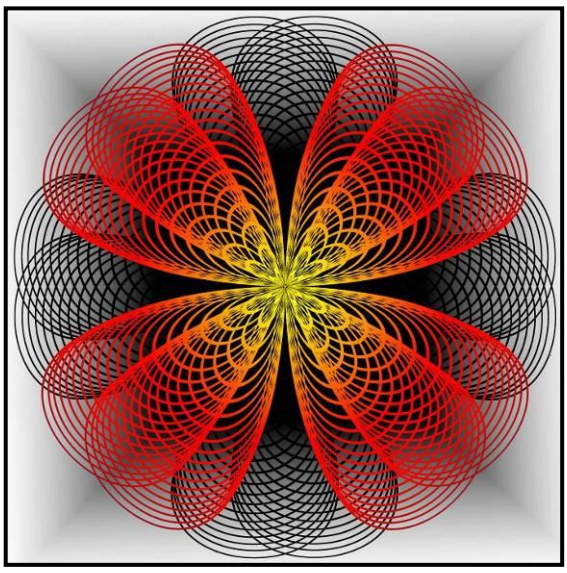


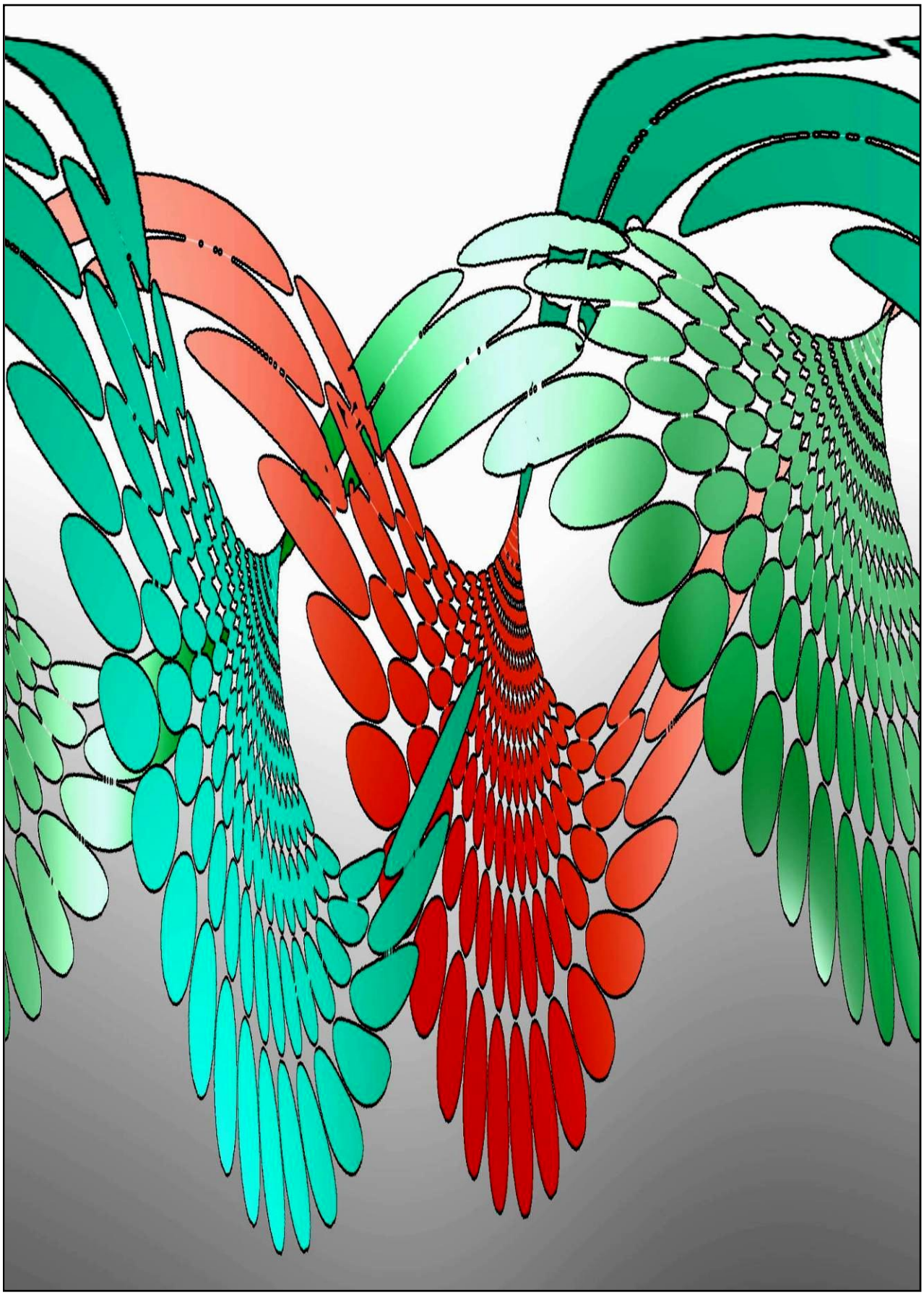


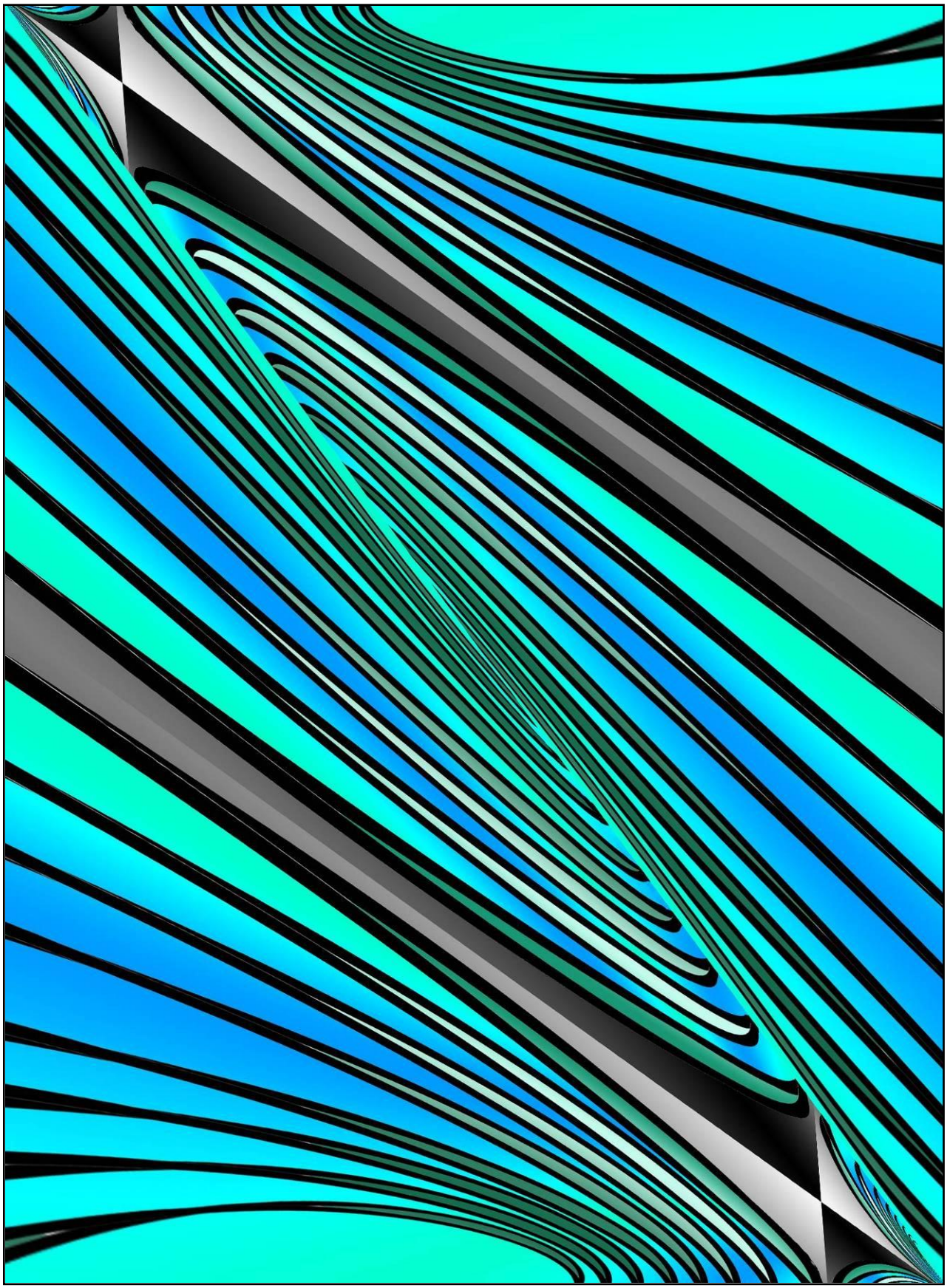










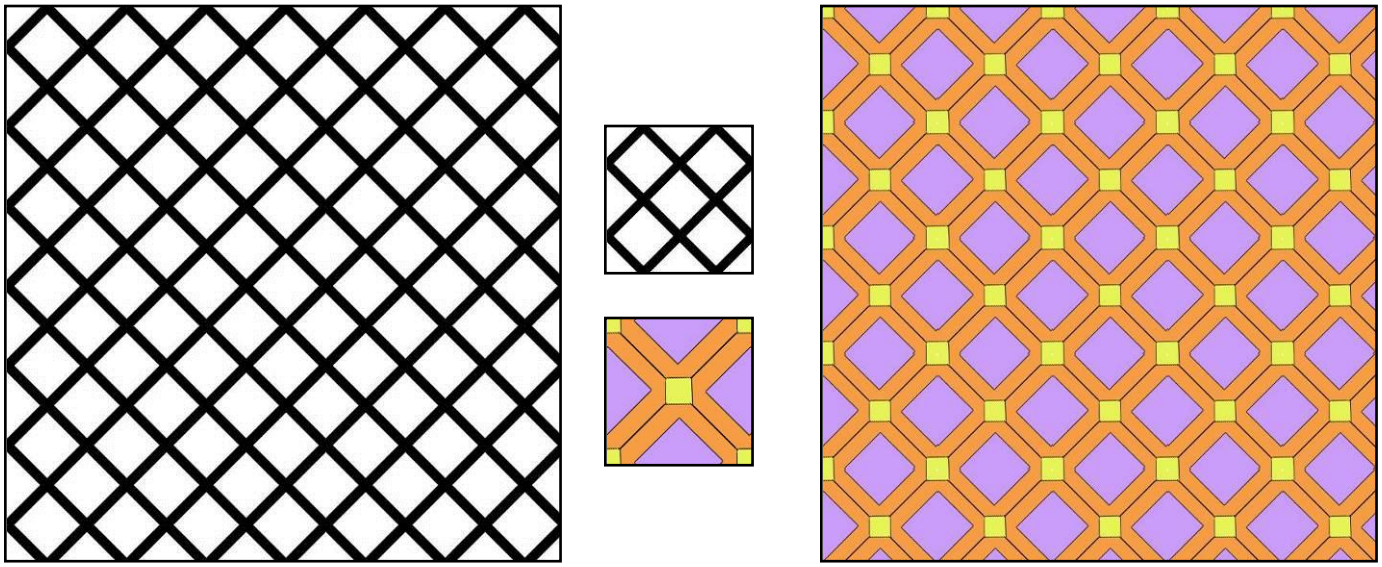


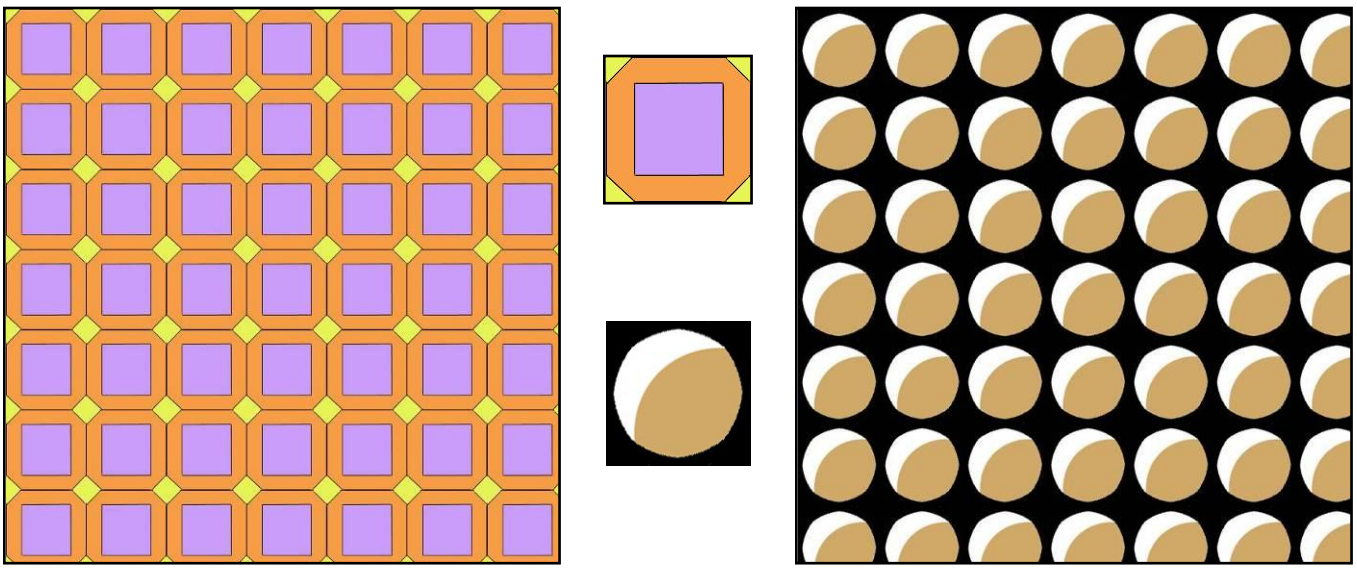
Les motifs et les pavages

PHOTOGRAPHIES

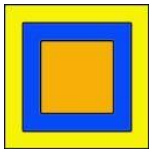
DIAPORAMA

Les motifs dessinés ou importés dans PHOTOSHOP seront réduits à une définition de 150 X 150 pixels ; ils seront stockes dans la mémoire de PHOTOSHOP (EDITION. ENREGISTREMENT DE MOTIFS) et utilisés par la fonction « seau de peinture » pour créer un pavage.

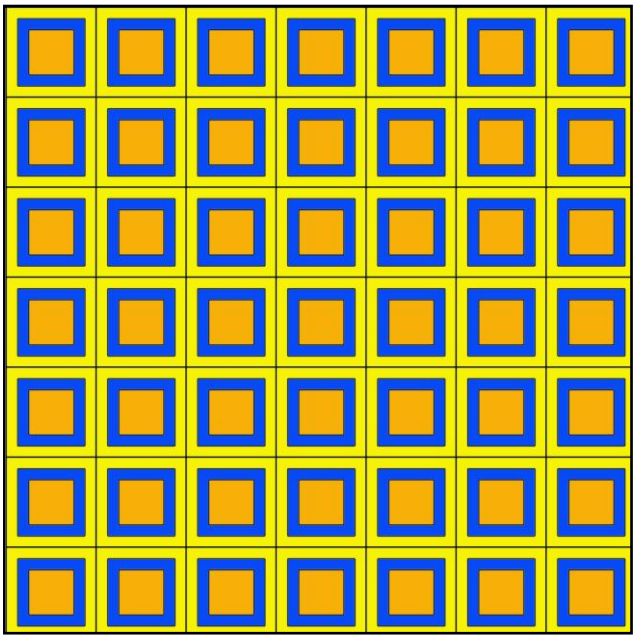


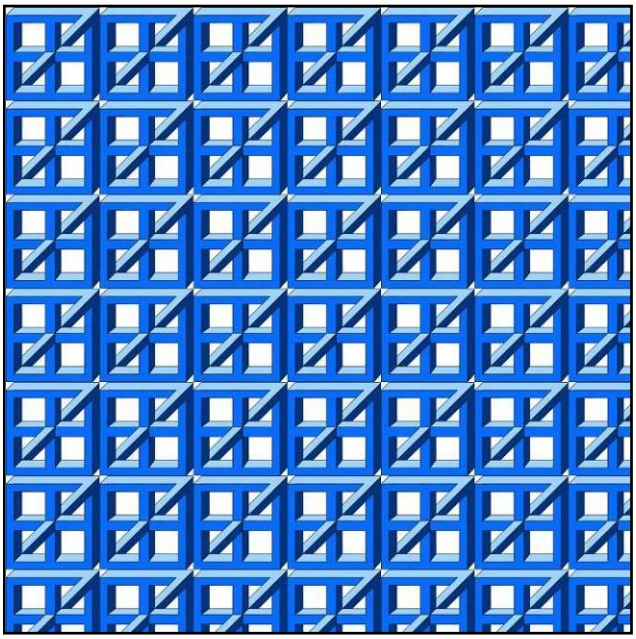


RETOUR



CONSTRUCTION





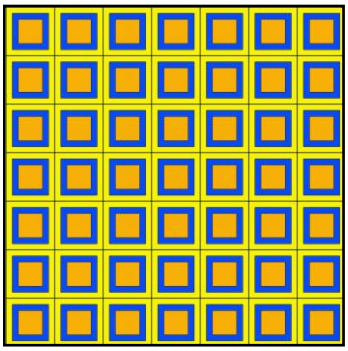
Pavages de définition 1000 X 1000 pixels créés avec les motifs correspondant (définition de 150 X 150 pixels) en utilisant le pot de peinture de la palette DESSIN.

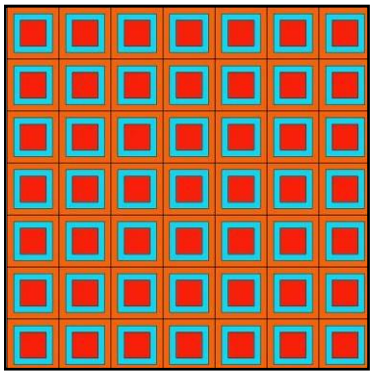
Déformation des pavages

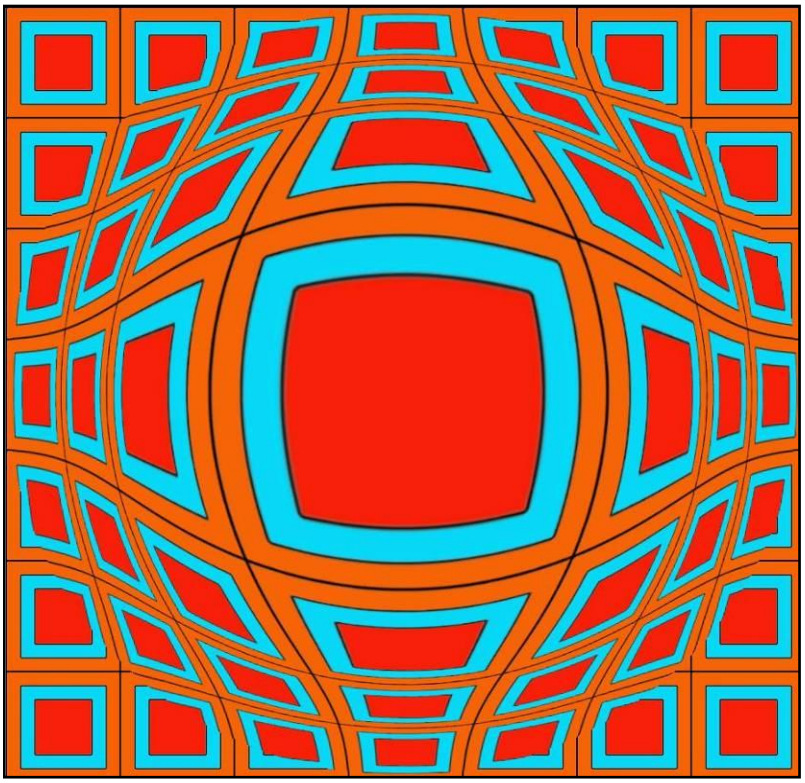
L'ordinateur permet les déformations de pavages :

par l'utilisation des possibilités de la palette dessin et des différents filtres (contraction, coordonnées polaires, sphérisation, translation, néon, 3D, contour lumineux, emballage plastic…),
par l'utilisation des transformations du menu image (perspective, transformations manuelles, rotations),
par le travail avec les calques (aplatir l'image avant tout enregistrement).
par l'utilisation de la fonction Copier et Coller.

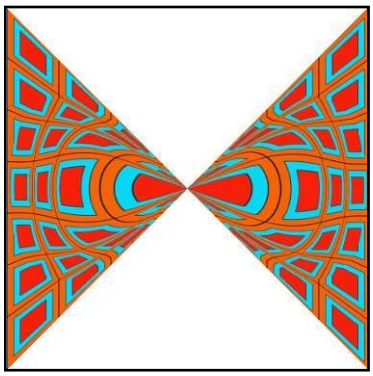
CONSTRUCTION

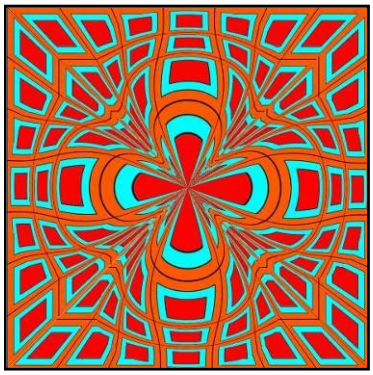


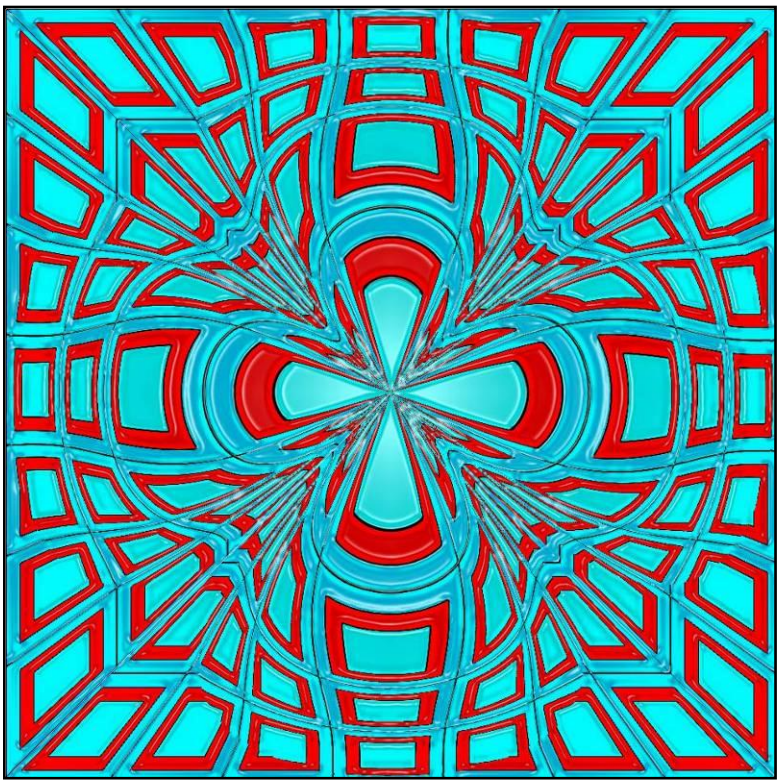




Dans l'ordre : pavage source ; changement de couleur ; sélection circulaire avec un contour progressif de 100, filtre sphérisation et filtre décontraction.

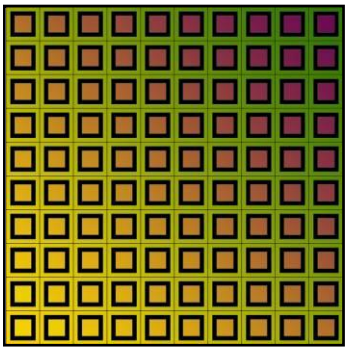


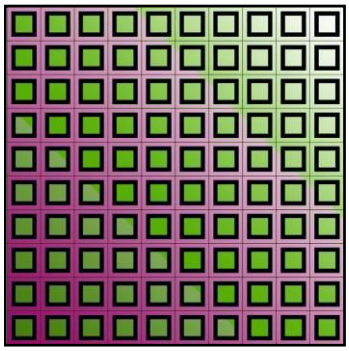


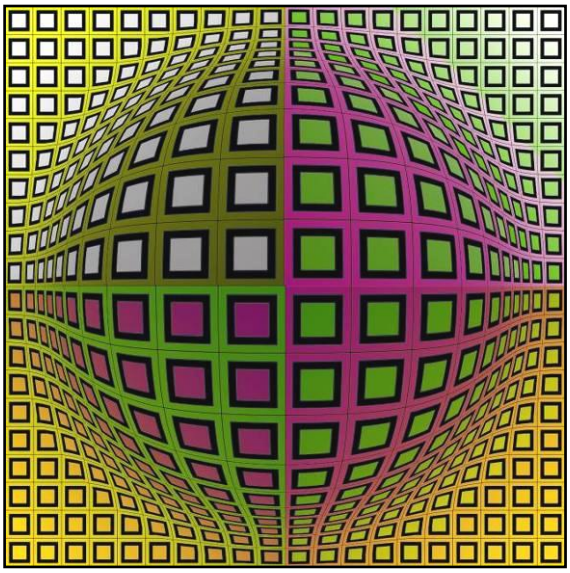


Sélection totale, perspective ; copier coller, rotation de 90°, aplatir les calques ; changement de couleur.

PHOTOGRAPHIES

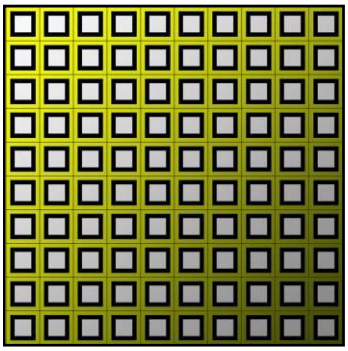


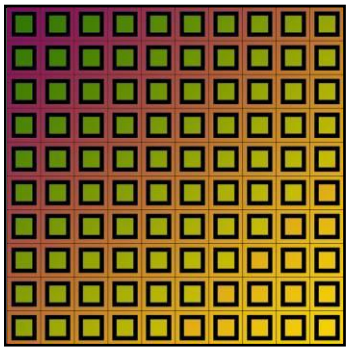


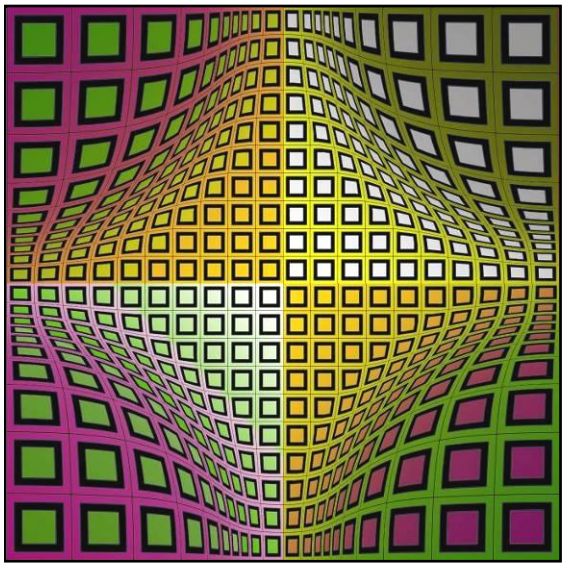


DIAPORAMA

CONSTRUCTION







Utilisation du pavage source :

Changement de couleur (ACCENTUATION et sous-menu COULEUR).

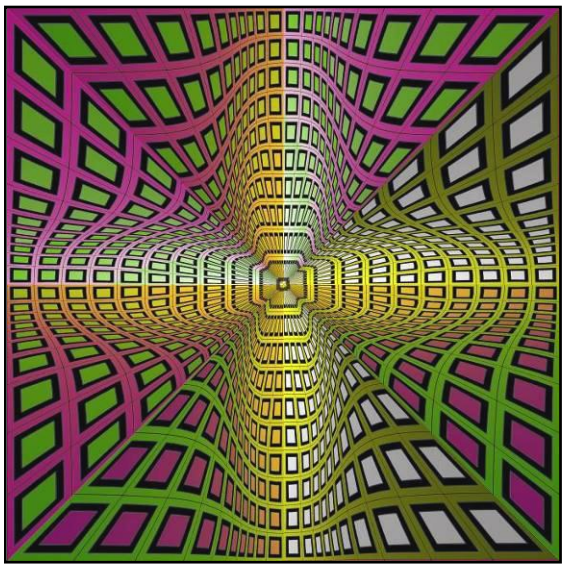
Dégradé (palette DESSIN, outil DEGRADE, mode TAMISE).

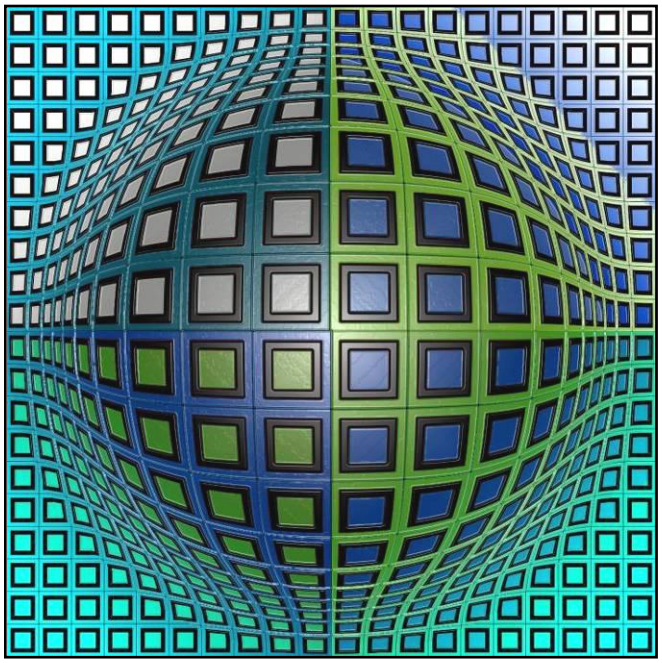
Déformation sphérique comme précédemment (filtre SPHERISATION).

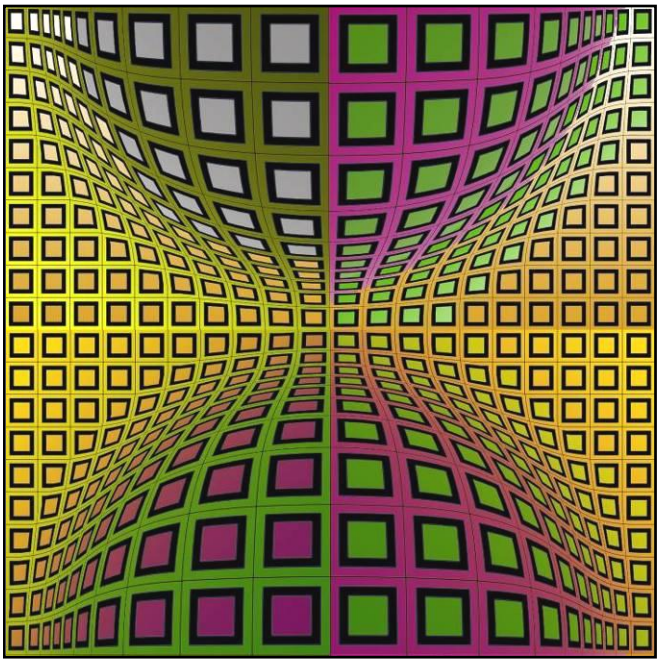
Translation de la moitié de la valeur en pixel du dessin (filtre TRANSLATION).

Contraction (filtre CONTRACTION)

L'effet désiré dépend de la valeur affichée pour chaque filtre et du type de sélection (sélection en carré, en cercle, contour progressif de cette sélection).





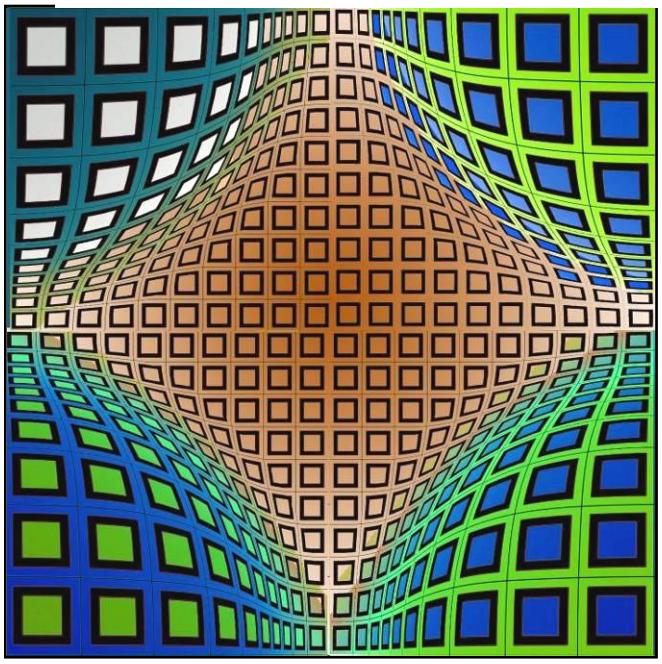


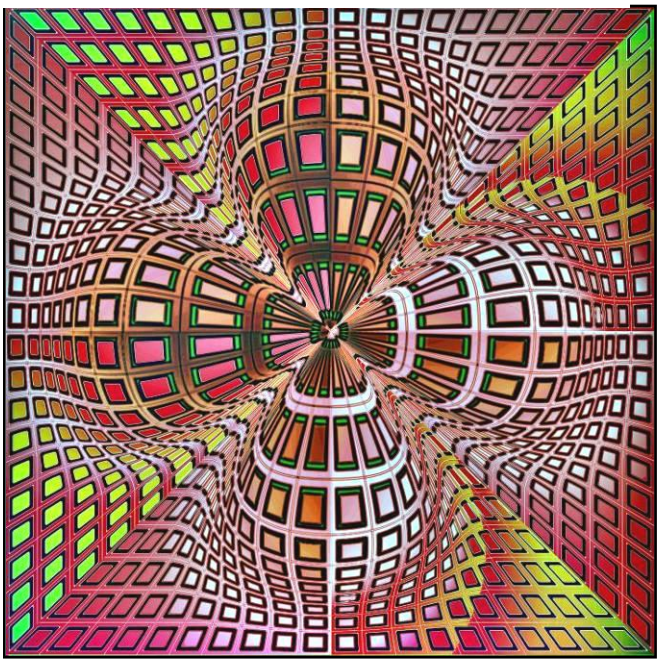
Changement de couleur et application du filtre EMBALAGE PLASTIC pour les reflets.
Translation verticale de la demie-valeur en pixel de l'image (filtre TRANSLATION).
Translation verticale et horizontale de la même valeur.
Utilisation comme précédemment de la fonction perspective (menu IMAGE, sous-menu TRANSFORMATIONS et PERSPECTIVE).

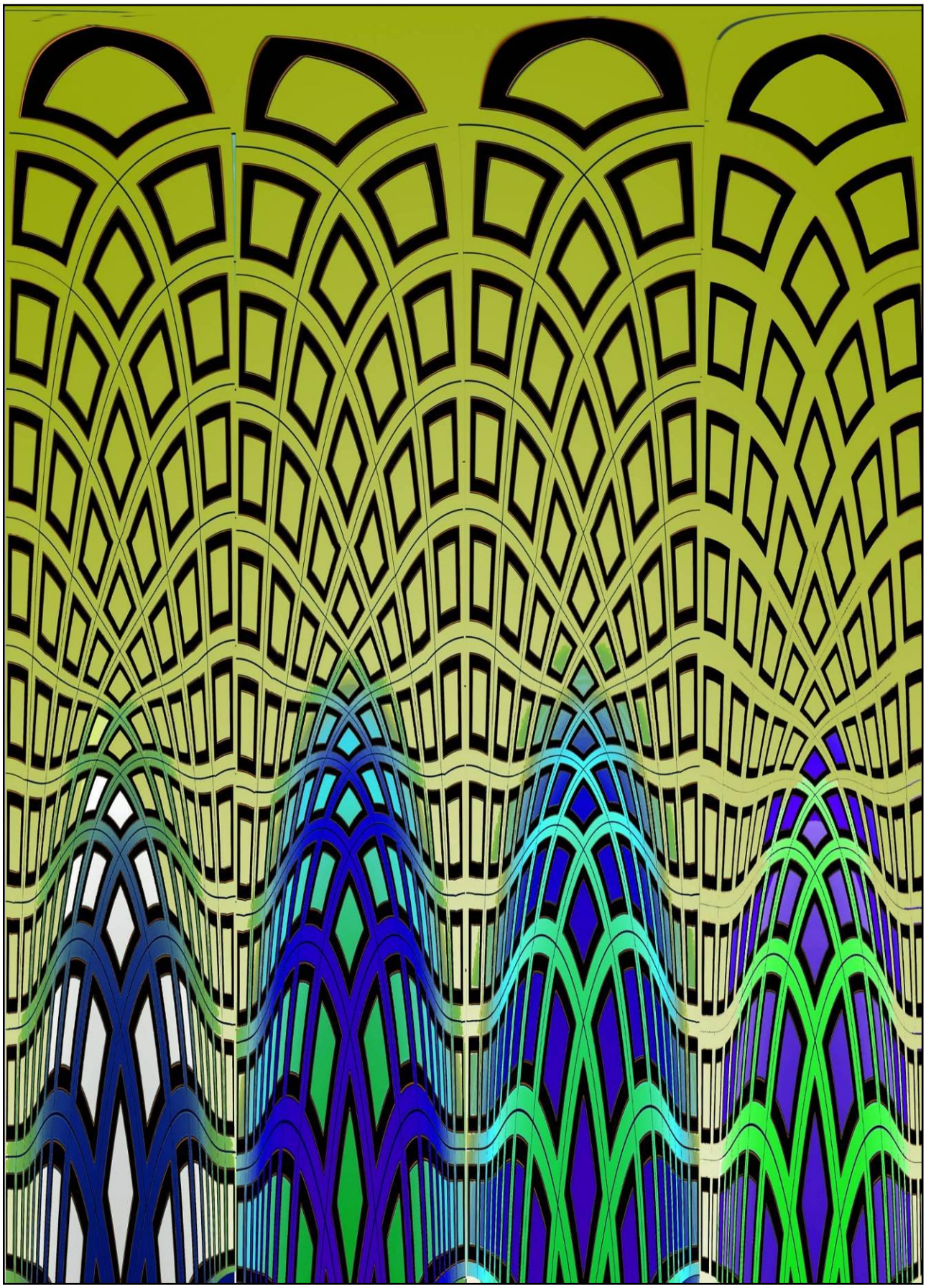
Pour les translations et les perspectives il est plus aisé de fixer la valeur en pixel de l'image de façon à avoir un carré (1000 X 1000 ou 3000 X 3000 …).

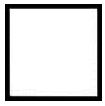
Page suivante : utilisation du filtre COORDONNEES POLAIRE (POLAIRE EN RECTANGULAIRE).

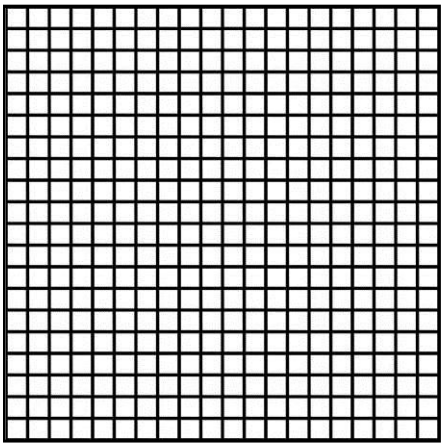
L'utilisation du filtre COORDONNEES POLAIRES permet la transformation des cercles en droites et vice-versa.

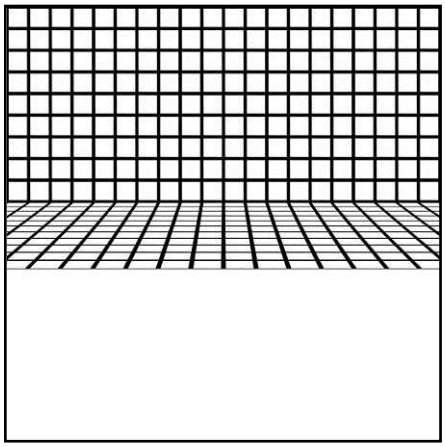


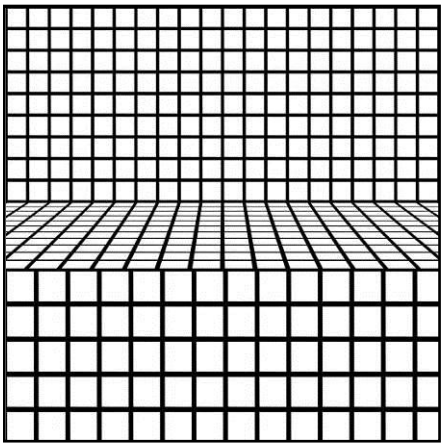


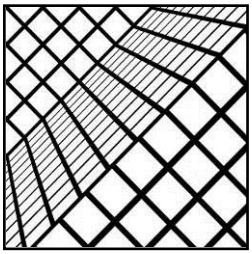


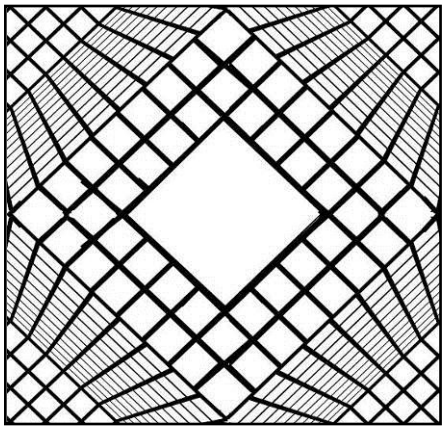












Cheminement permettant de construire un quart du dessin :

Choix du motif et construction du pavage (carré).

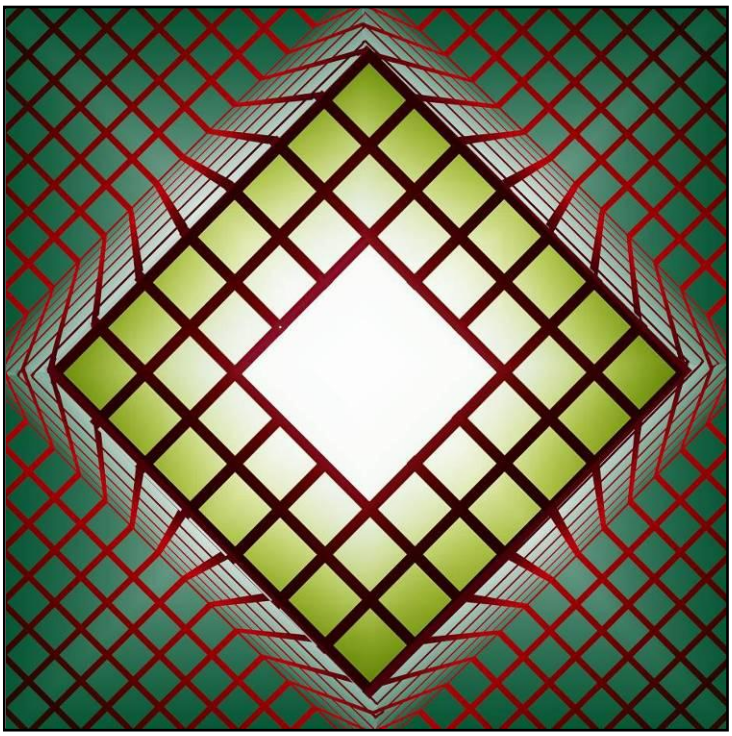
Effet de perspective : PERSPECTIVE et TRANSFORMATION MANUELLE).

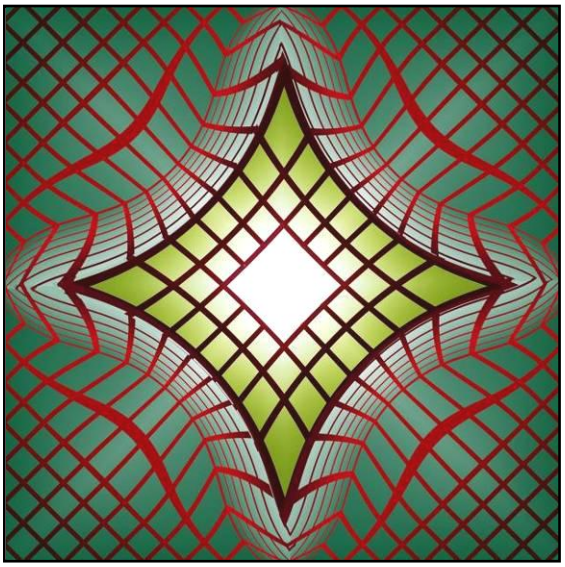
Rajout de la partie basse en ajustant les dimensions (COPIER COLER et TRANSFORMATION MANUELLE).

Sélection du quart et rotation de 45°.

Duplication du quart pour terminer.

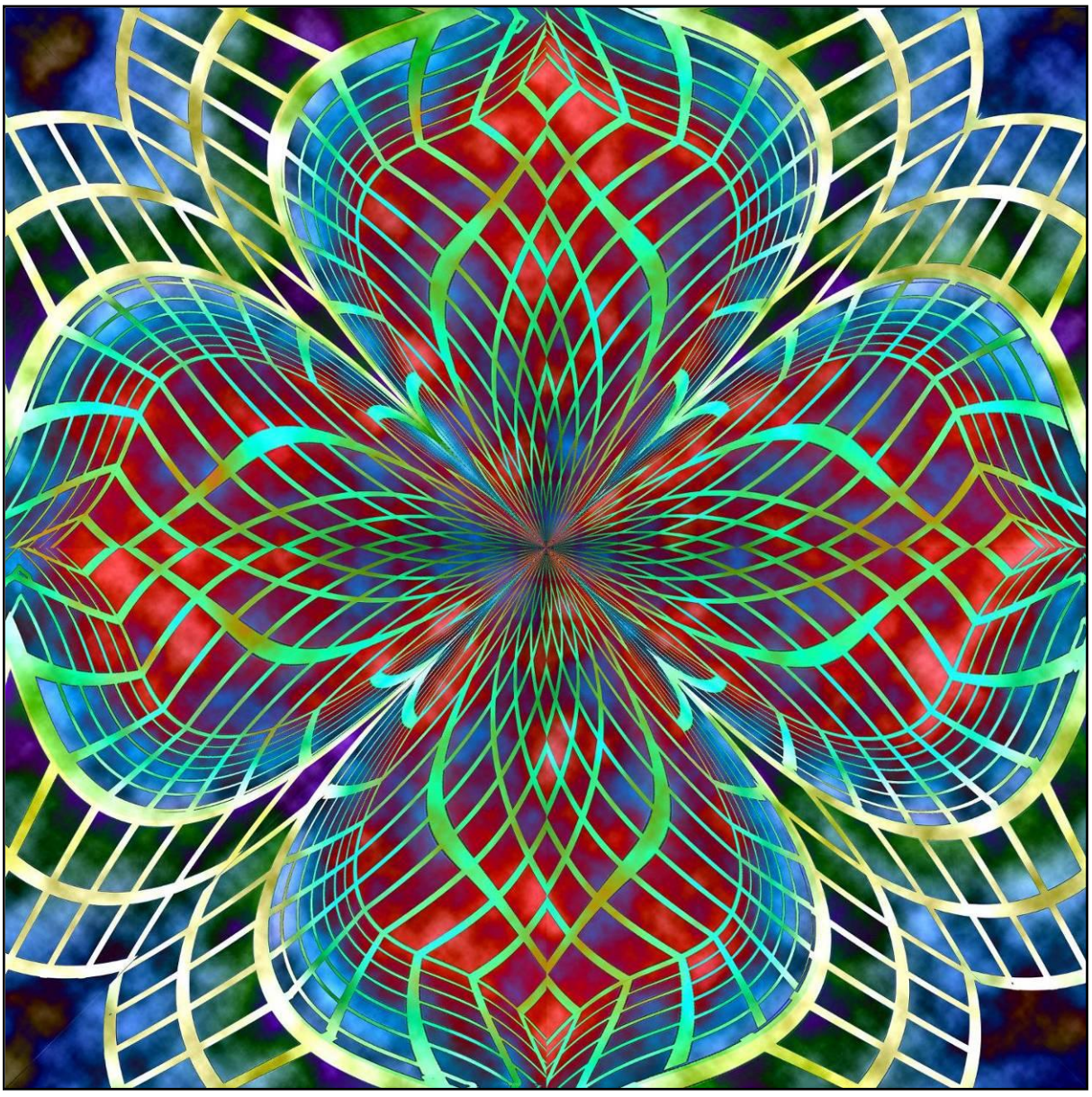
Sélection des différentes parties pour la couleur et les dégradés (trois zones).

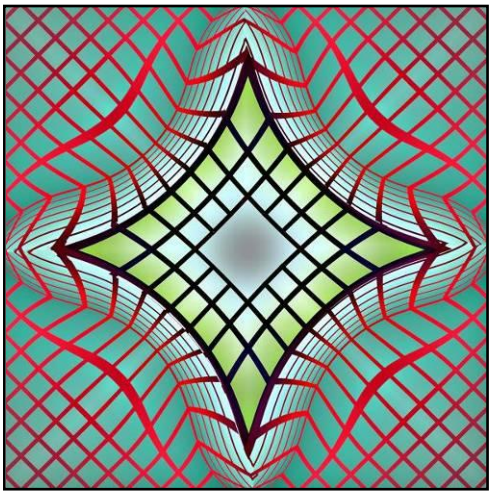




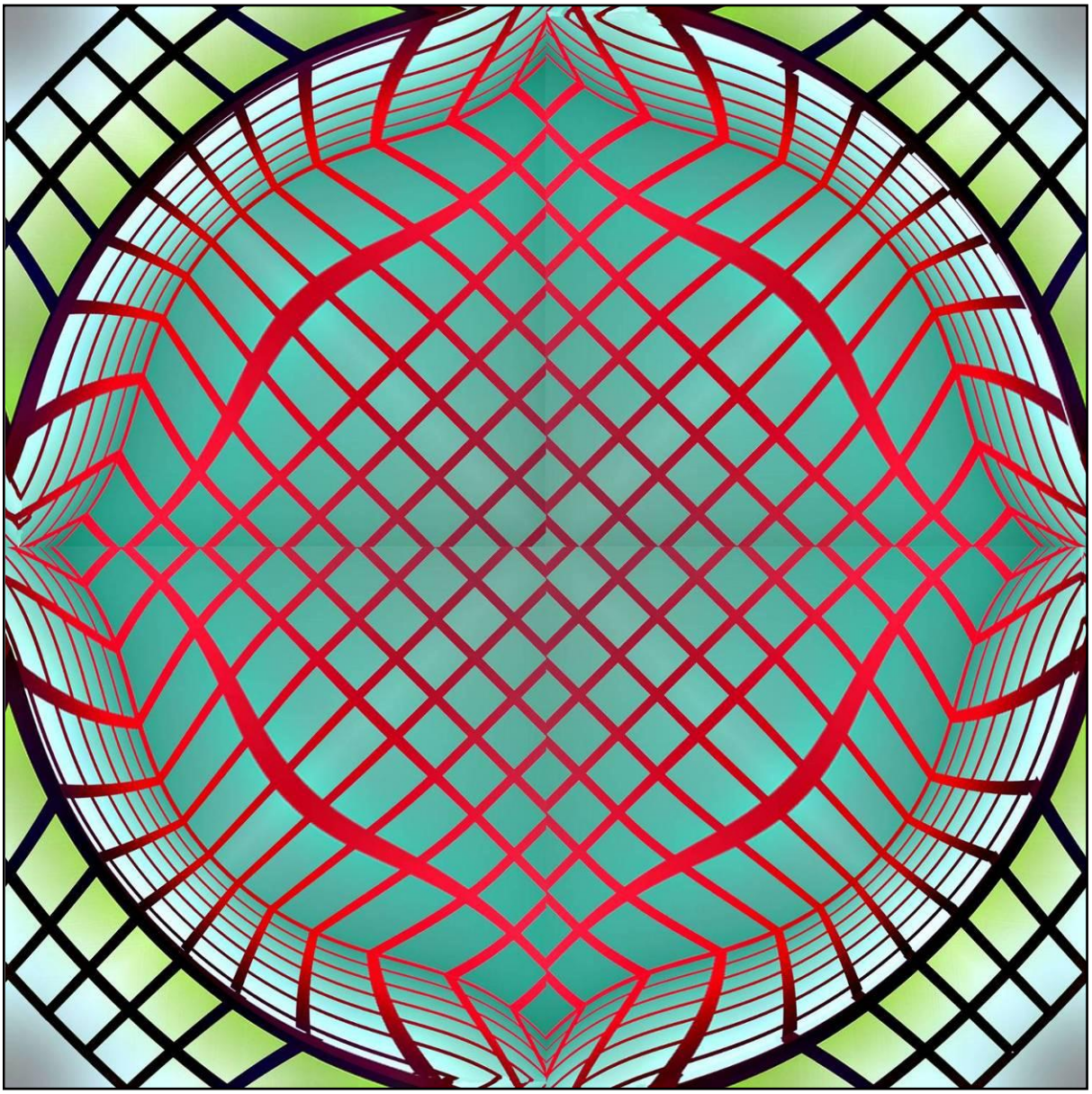
PHOTOGRAPHIES

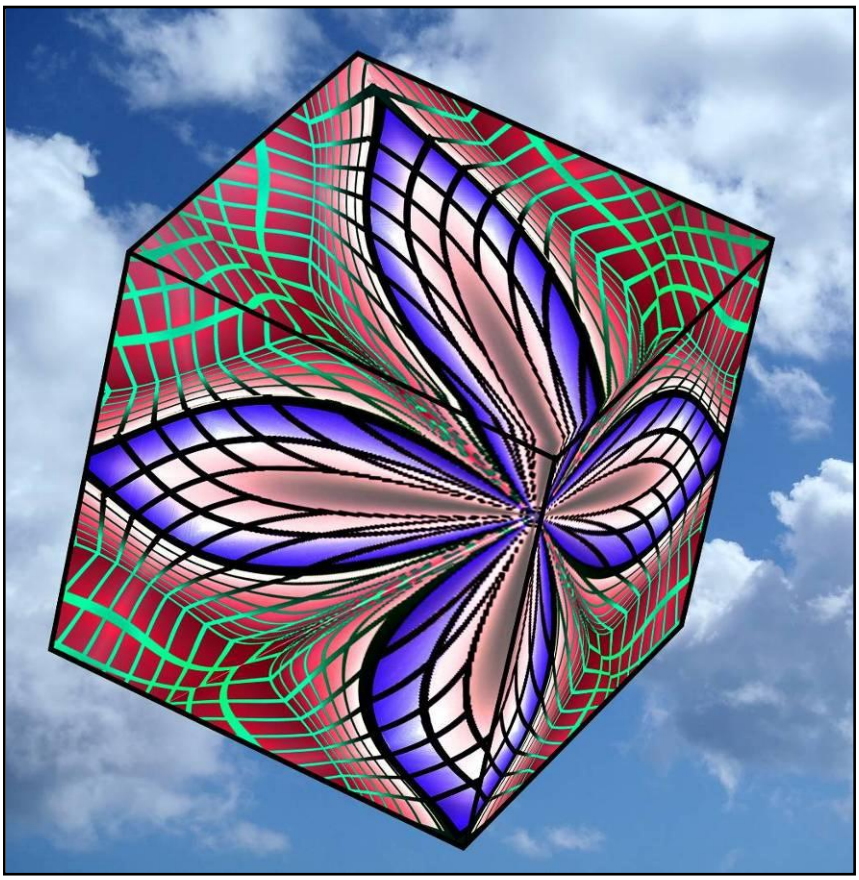
Contraction de l'ensemble (filtre CONTRACTION).
Effet perspective.
Sélection du trait noir ; COUPER et resélectionner.
Coloration en utilisant le filtre NUAGE PAR DIFFERENCE.





Changement de couleur.
Translation horizontale et verticale de la moitié de la valeur en pixels du dessin (filtre TRANSLATION).

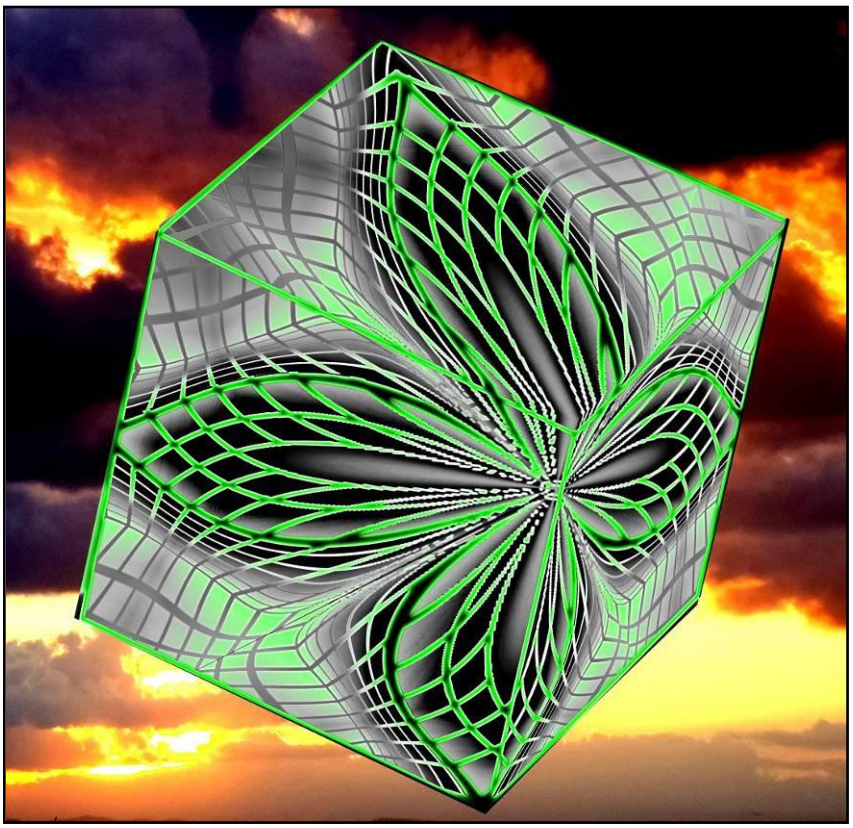


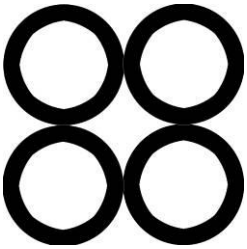


Transformation 3D du dessin : filtre TRANSFORMATION 3D choix du carré et de l'option sans fond.
Reprendre les arêtes du cube (palette dessin SEGMENT et aplatir l'image).

Sélectionner le cube avec ses arêtes, sélectionner un fond et transporter le cube sur ce fond.

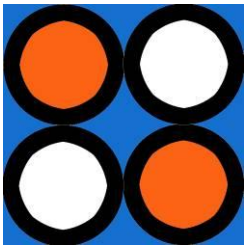
Effet NEON pour la coloration du cube de droite.

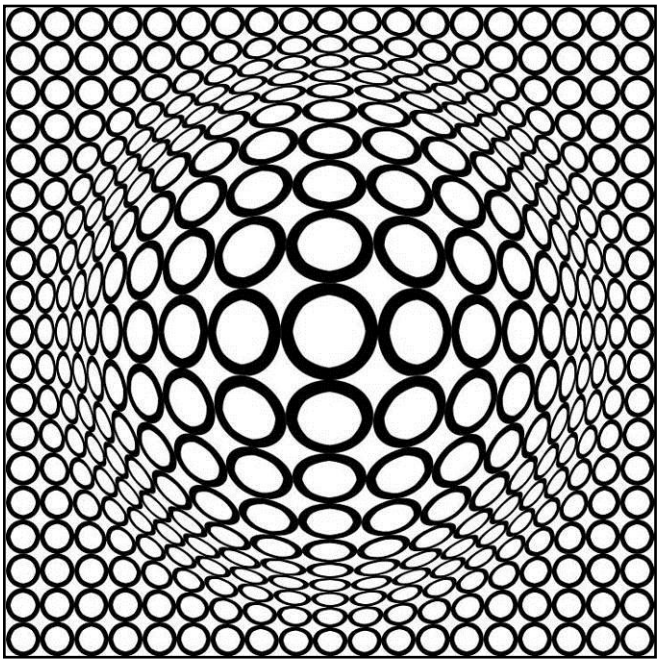


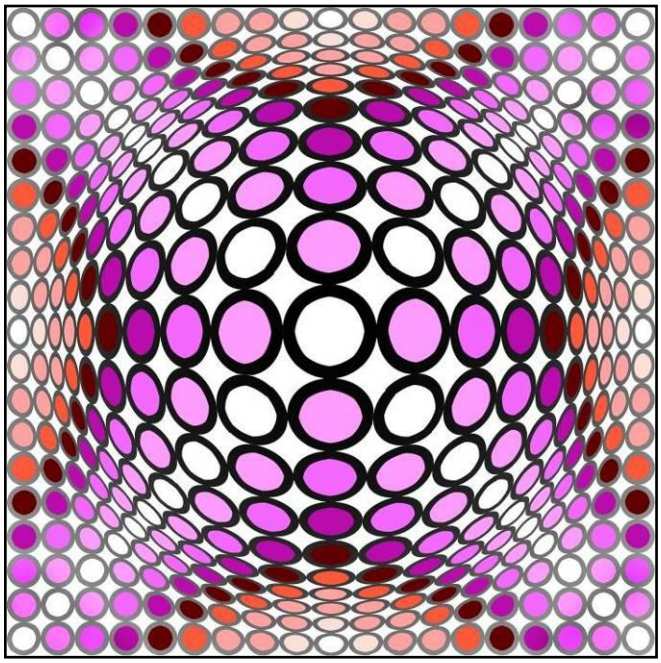


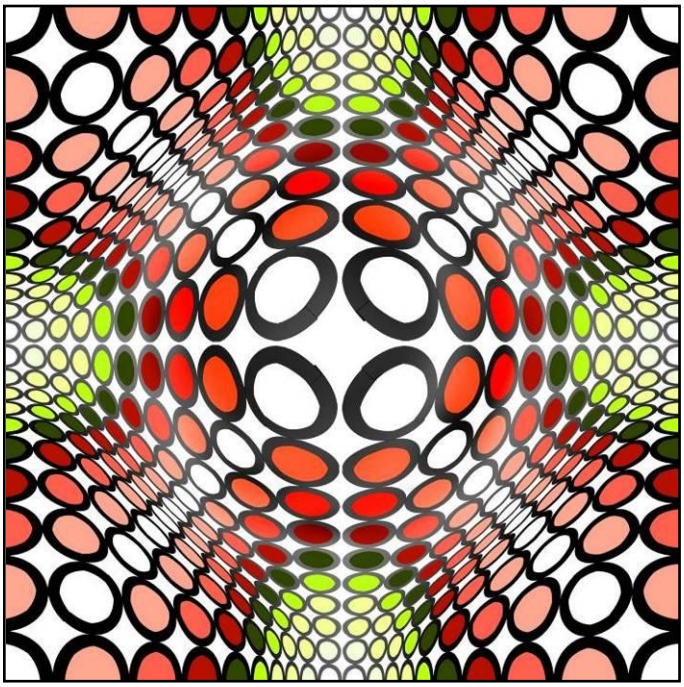
CONSTRUCTION

CONSTRUCTION



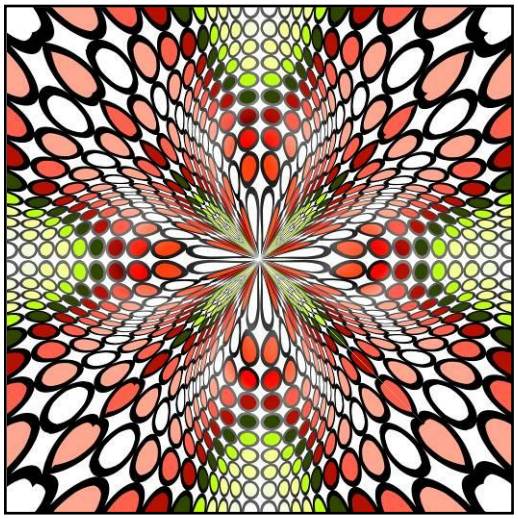




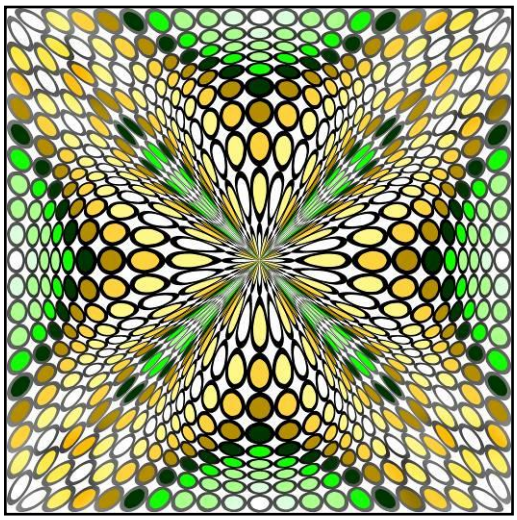


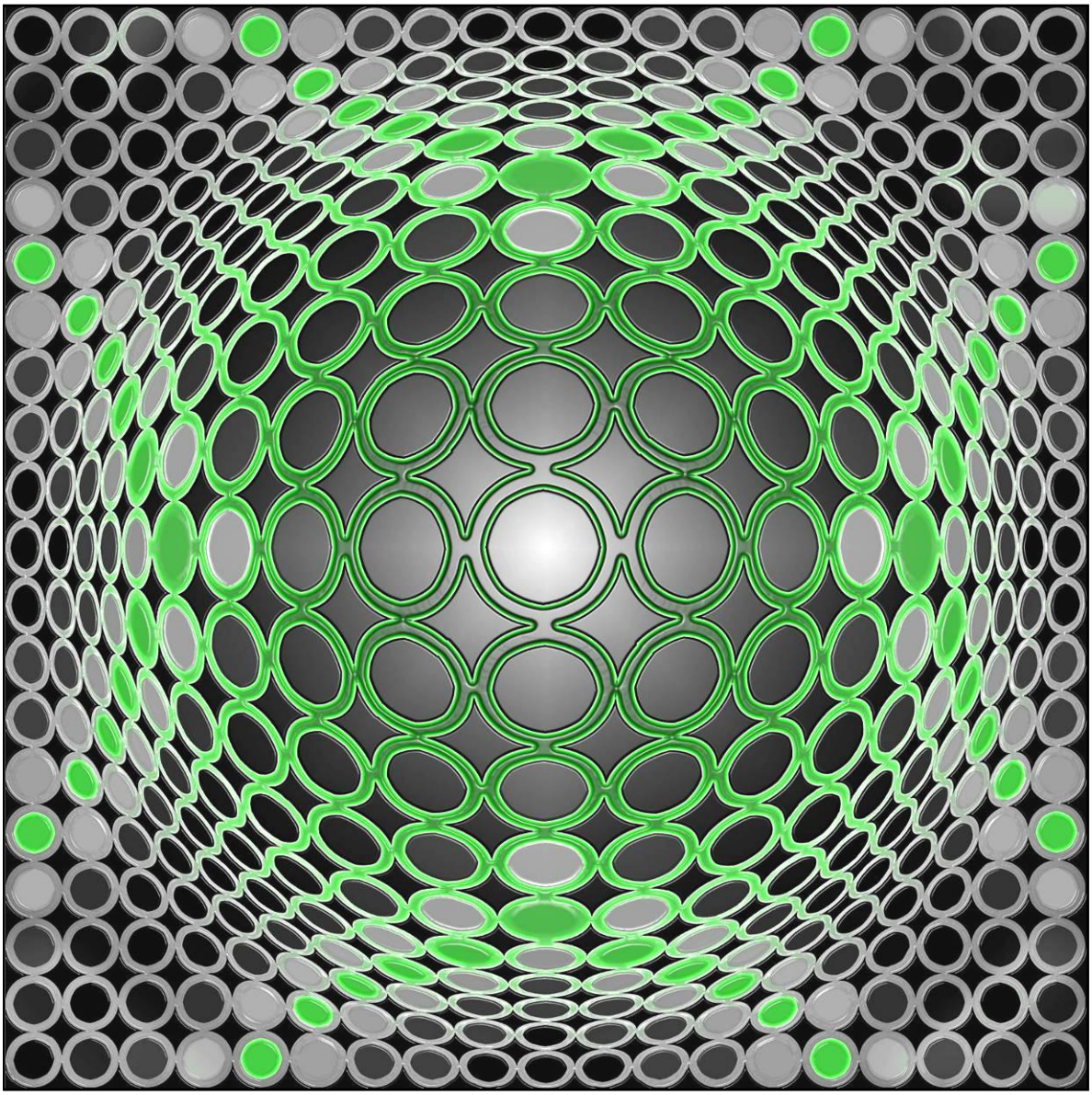
Ci-dessus, sphérisation du pavage, les dégradés des différentes couleurs donnent du volume à l'ensemble.

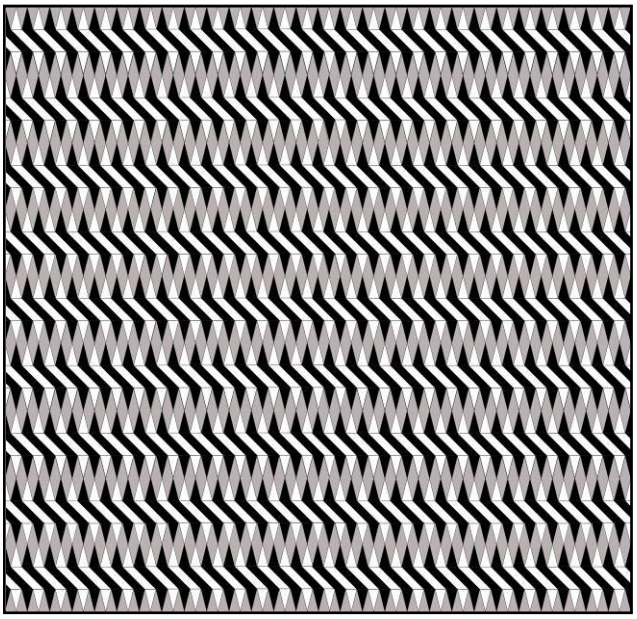
A gauche, translation horizontale et verticale de la demie valeur en pixels de la figure ; sélection circulaire du centre et utilisation du filtre CONTRACTION pour dilater le centre de cette sélection.

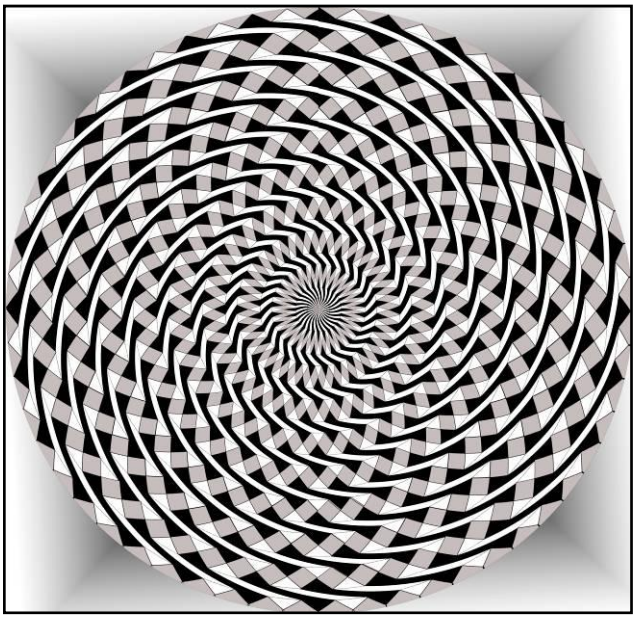


Sélection du trait noir de chaque cercle, couper, resélectionner, tracer le contour **extérieu**r de la sélection et effectuer toute une série de dégradés sur le trait, le fond et l'inter trait.

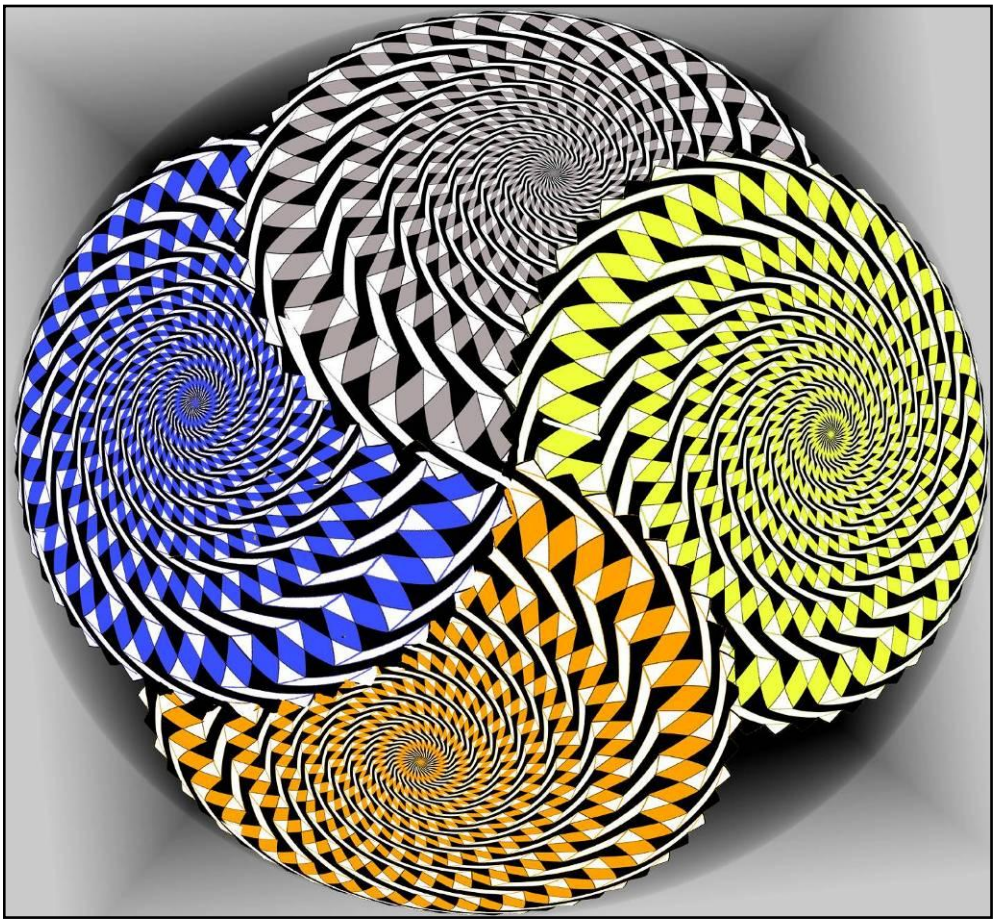


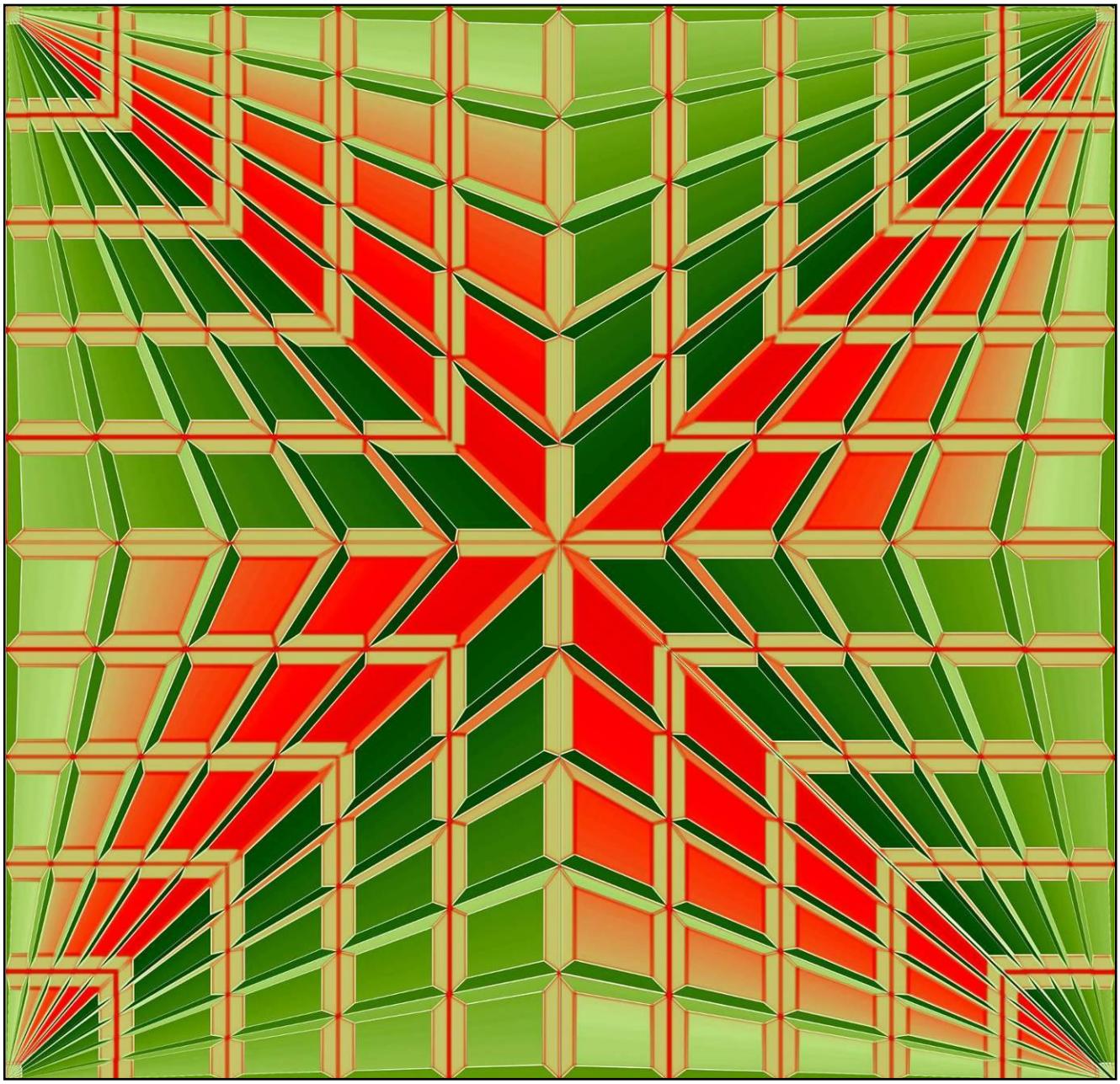


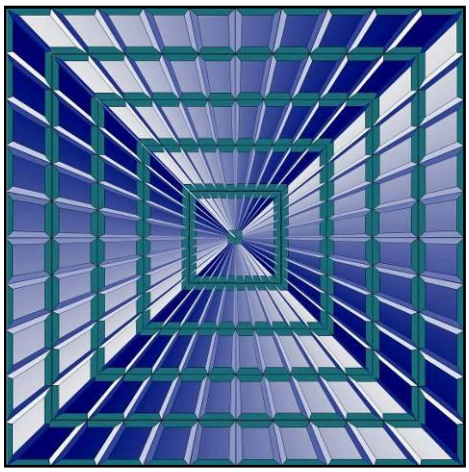




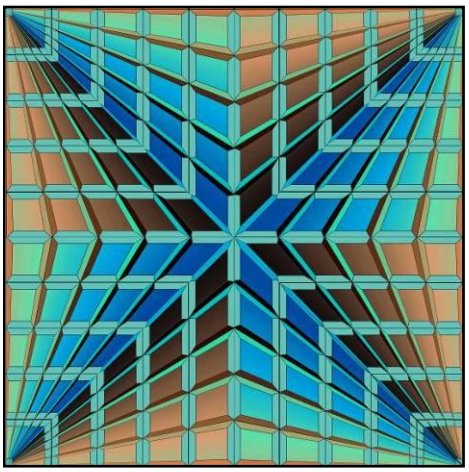
Le pavage ci-dessus traité avec le filtre COORDONNEES POLAIRE (rectangulaire en polaire) donne une illusion optique saisissante : les spirales qui semblent former cette figure ne sont en fait que des cercles concentriques.

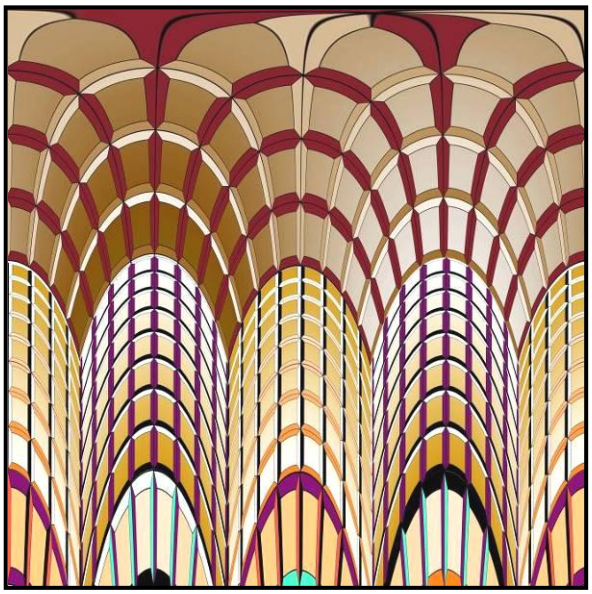






Le pavage est dégradé puis traité en perspective et après un changement de couleur, il subit une double translation (verticale et horizontale).





Le dessin issu du précédent, est obtenu par le filtre COORDONNEES POLAIRE (polaire en rectangle).

La symétrie verticale permet après ajustements de construire la figure ci-dessous :

Sélection totale.

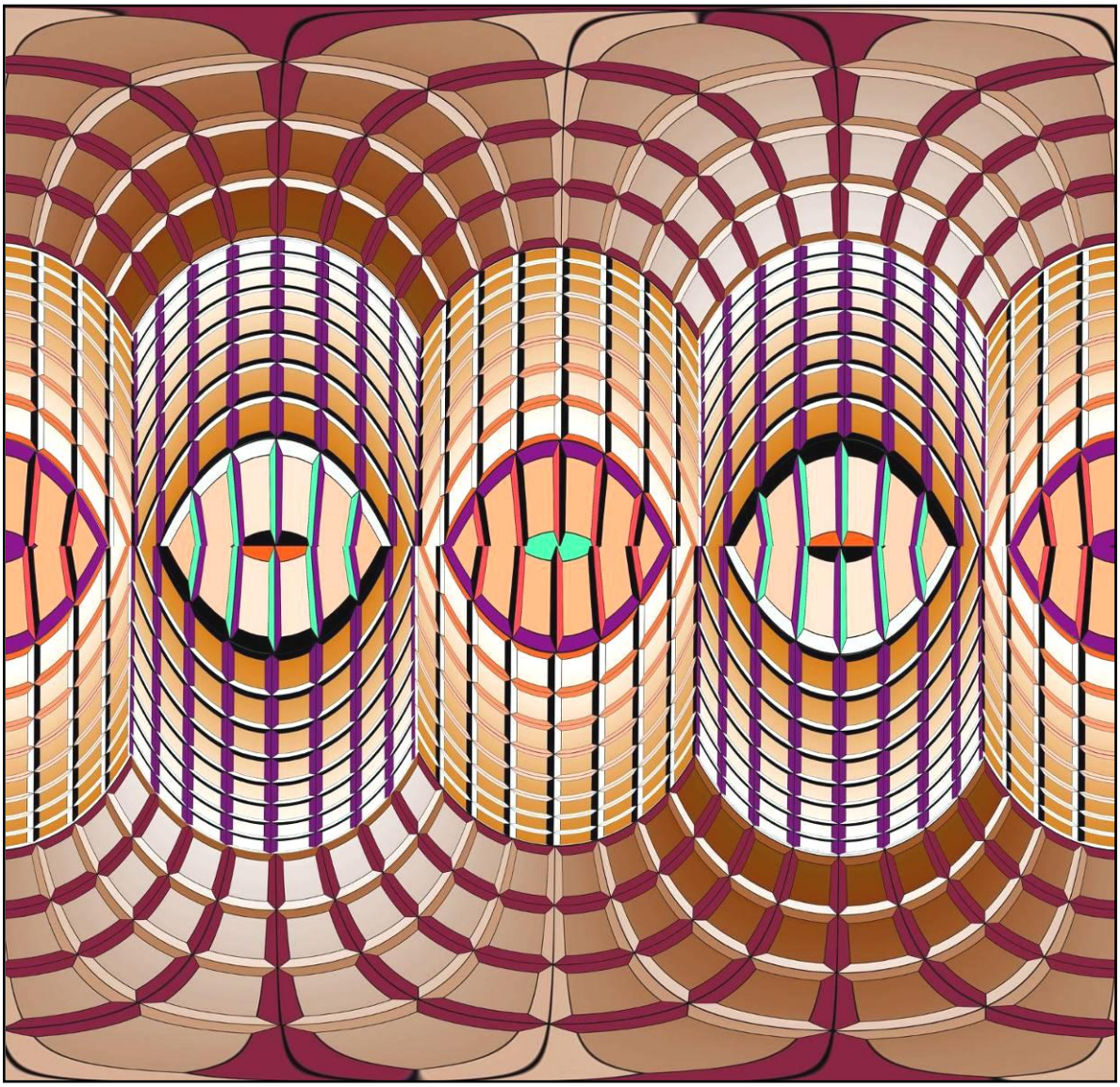
TRANSFORMATION MANUELLE diminution horizontale de la moitié.

COPIER et COLLER.

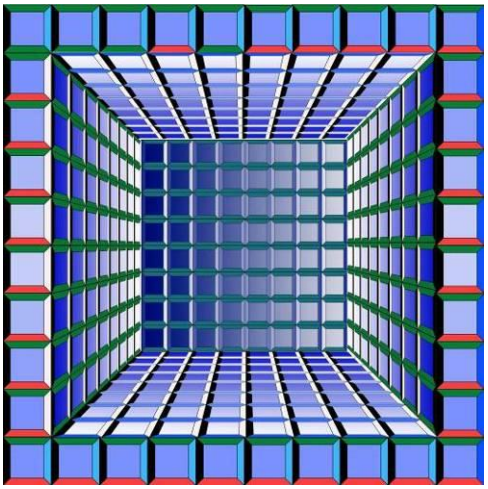
Symétrie verticale.

Déplacement vers le bas de la sélection (palette dessin).

Ajustements.

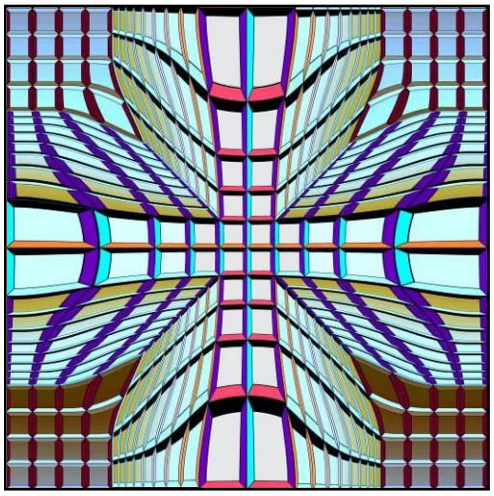


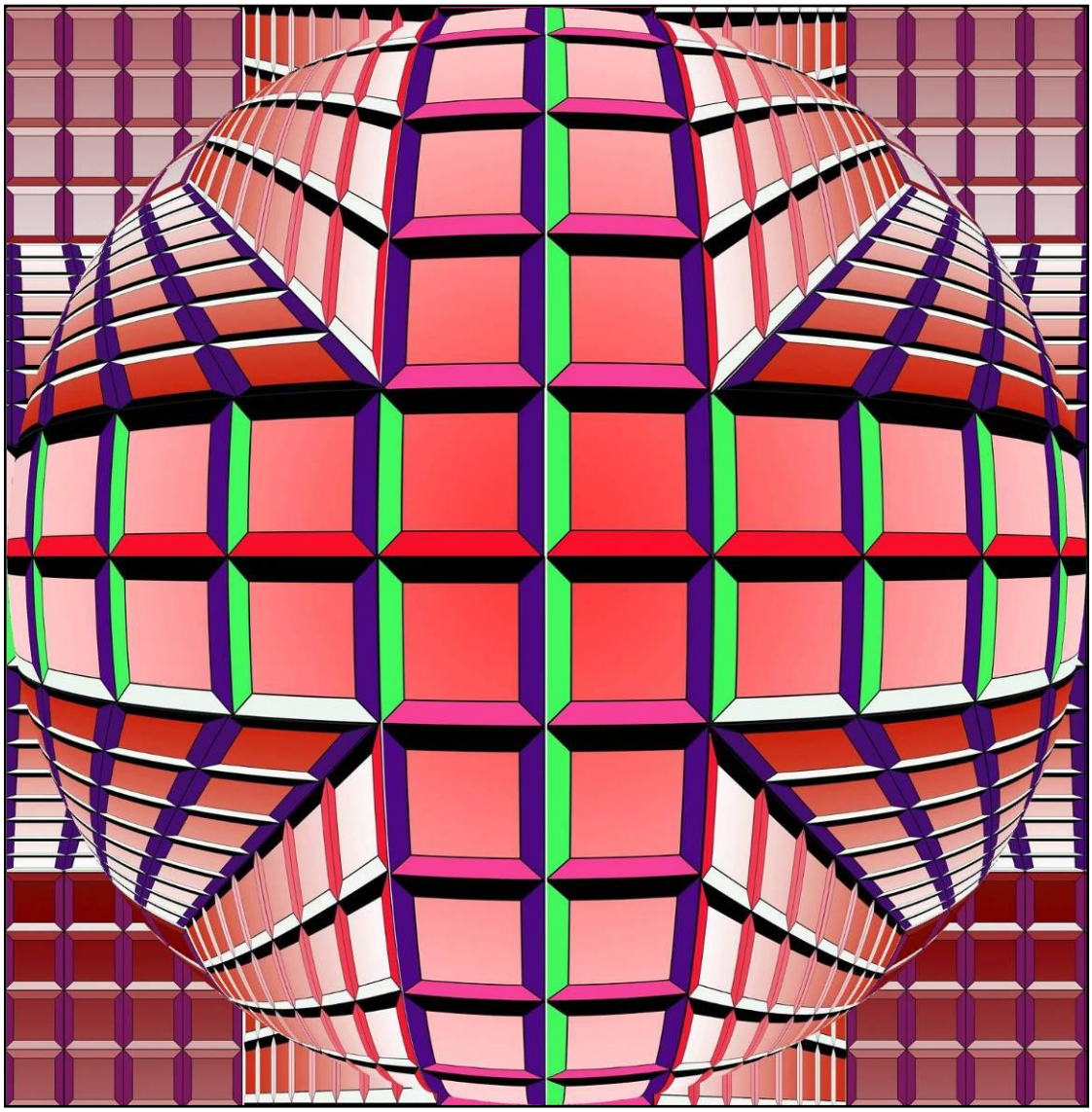
CONSTRUCTION

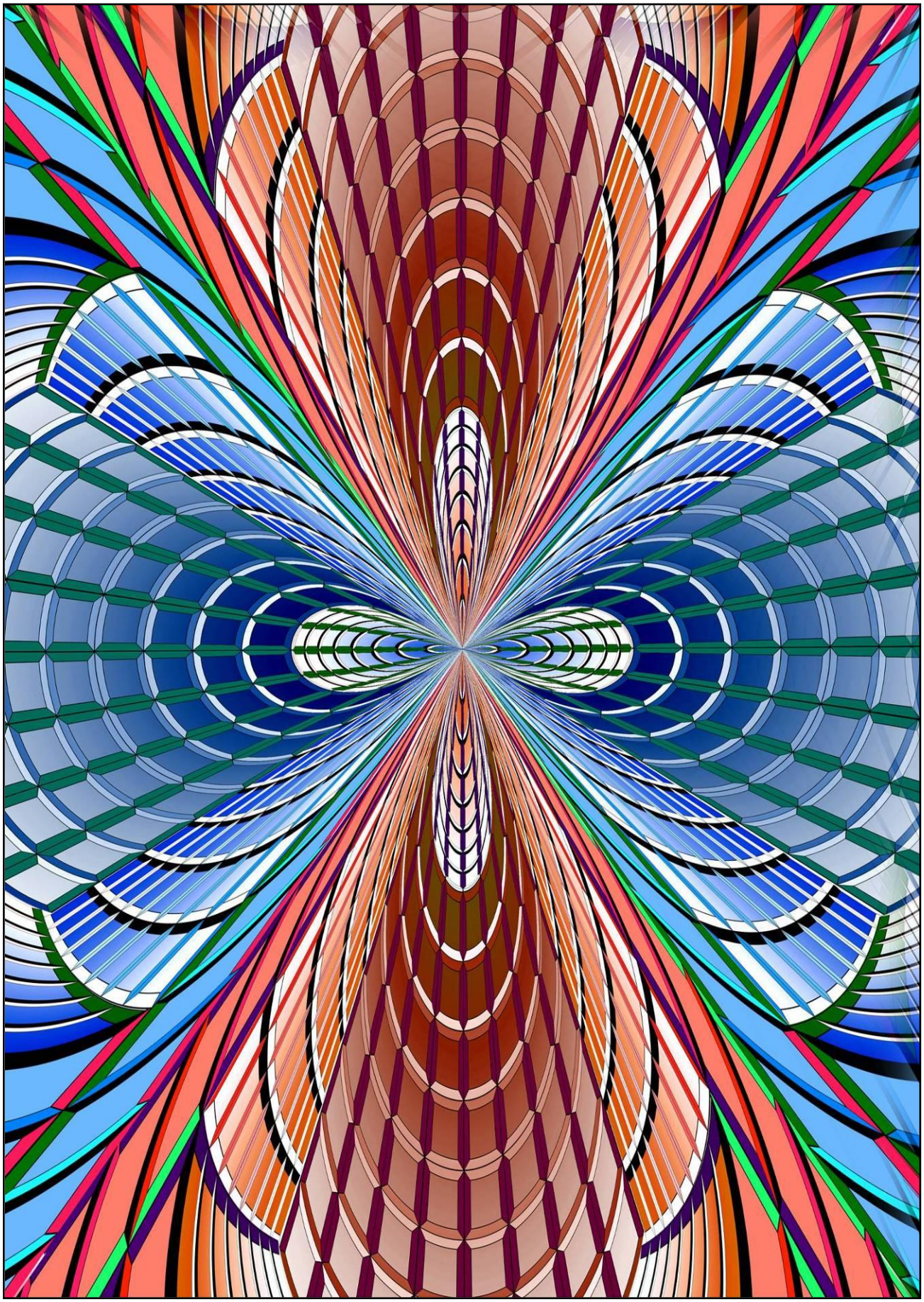


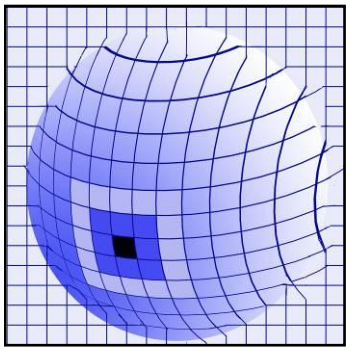
Double translation et filtre CONTRACTION.

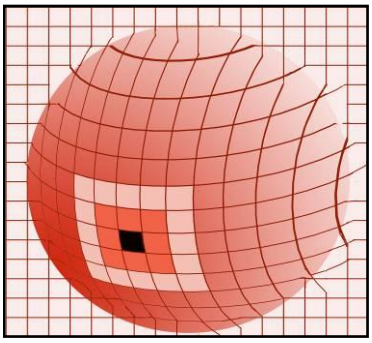
Double translation, sélection en cercle, filtre CONTRACTION en dilatation.











Sur un pavage de fond en carrés :

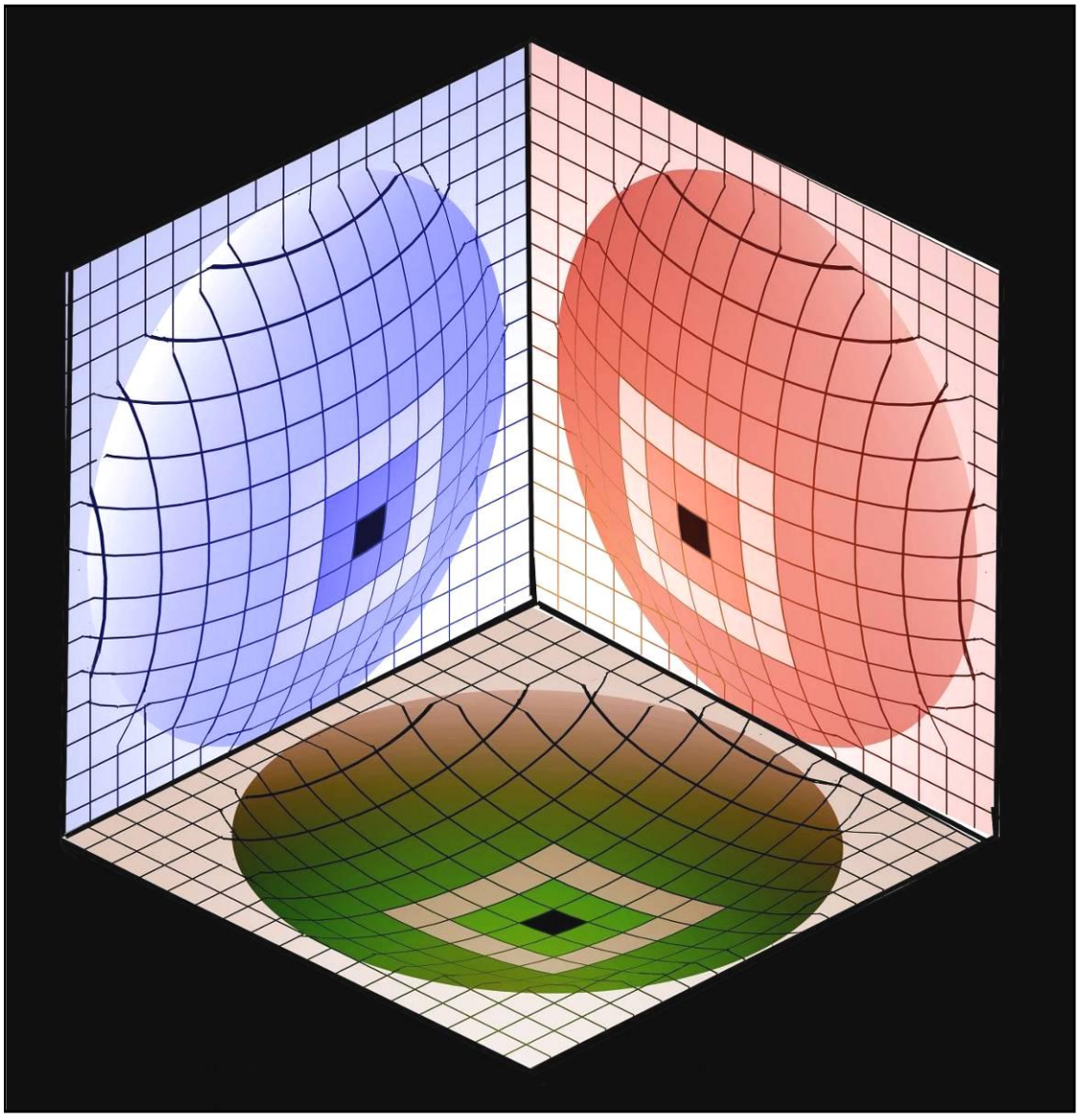
Sélection circulaire

Filtre CISAILLEMENT appliqué à la sélection

Dégradé de la sélection; faire les trois images correspondant à chaque face

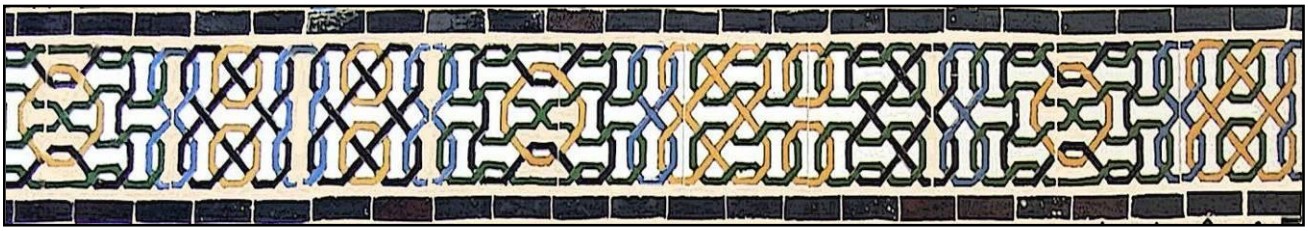
Changement de couleur des carrés intérieurs

Confection du cube : fonctions perspective, transformation manuelle, déplacement, confection des arêtes.

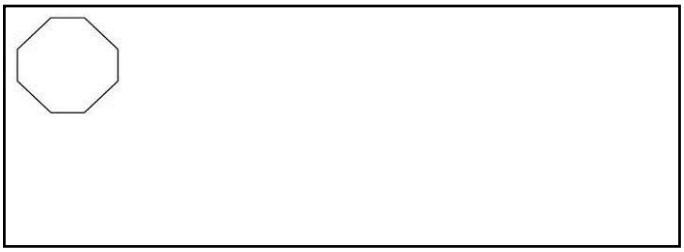


Technique de dessin et de reproduction.

Création et **transformation** d'une frise :



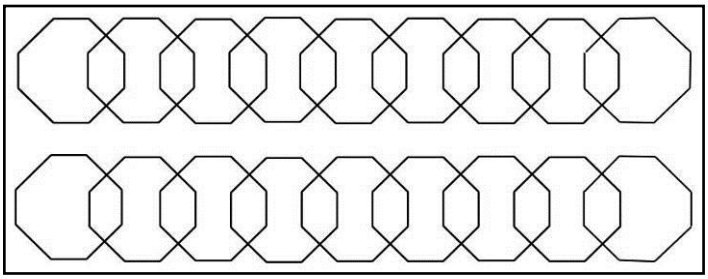
La construction de cette frise débute par le choix et le dessin des modules (un seul dans le cas considéré) ; leurs liaisons ; le dessin des entrelacs et la couleur.



Pour dessiner ce motif avec Photoshop :

.

Le dessin s'effectue en utilisant la **grille**, l'option **magnétisme** et l'option **trait** (palette dessin, épaisseur 12). Chaque trait ou chaque copie crée un calque ; il faut donc régulièrement **aplatir l'image** pour avoir accès à l'ensemble du dessin (CALQUES : **aplatir l'image**).



Dessin de l'octogone :

L

Trois carreaux en diagonales et trois carreaux en horizontaux suivant la grille ; le magnétisme pose automatiquement les extrémités du trait aux intersections de la grille. **Aplatir l'image** (suppression des calques). Remarque : l'octogone ainsi créé n'est pas régulier.

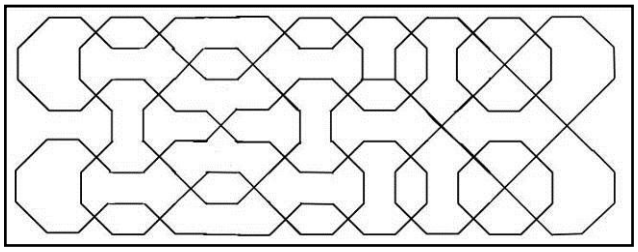
Sélectionner **seulement le trait** avec la **baguette magique** et dans le menu EDITION, **copier** et **coller** cet octogone en le **positionnant** chaque fois à sa place. Répéter l'opération **coller** 17 fois. Aplatir ensuite l'image (CALQUES : **aplatir l'image**).

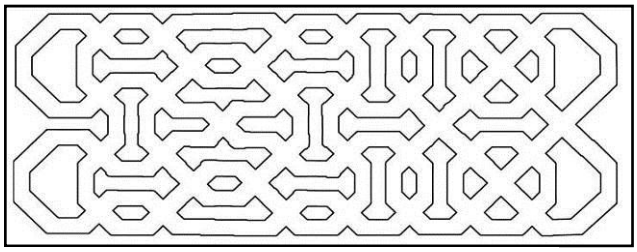
RETOUR

La liaison des modules s'effectue avec l'option **trait** et l'option **gomme** ; ne pas oublier d'**aplatir l'image** avant de gommer.

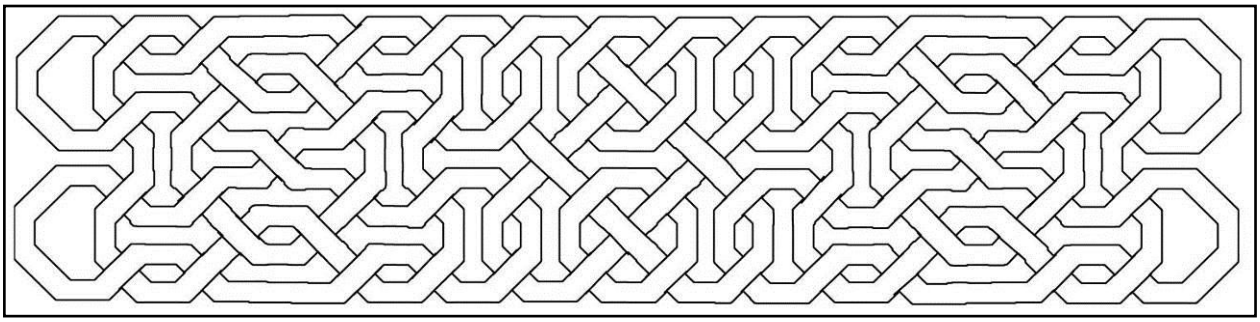
Pour fabriquer les entrelacs : sélectionner le trait avec la **baguette magique**, dans **sélection**, demander la dilatation de la sélection de façon à équilibrer l'épaisseur du trait avec les espaces (**SELECTION** : modification, **dilater**).

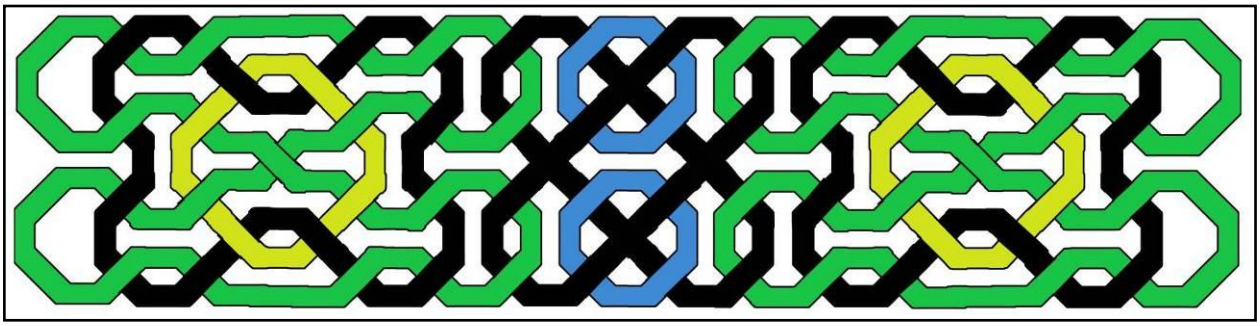
Demander le coupage du trait de l'intérieur de la sélection (EDITION, **couper**) ; ré-sélectionner car la sélection a disparue au coupage (SELECTION : **resélectionner**) ; dans EDITION choisir l'option **contour** pour marquer le trait de la sélection.



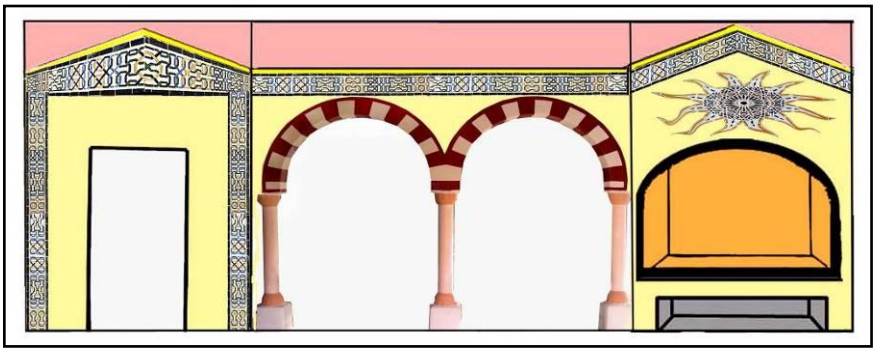


Le laçage des entrelacs s'effectue avec l'option **trait** ; ne pas oublier d'**aplatir l'image**. Agrandir l'image par symétrie

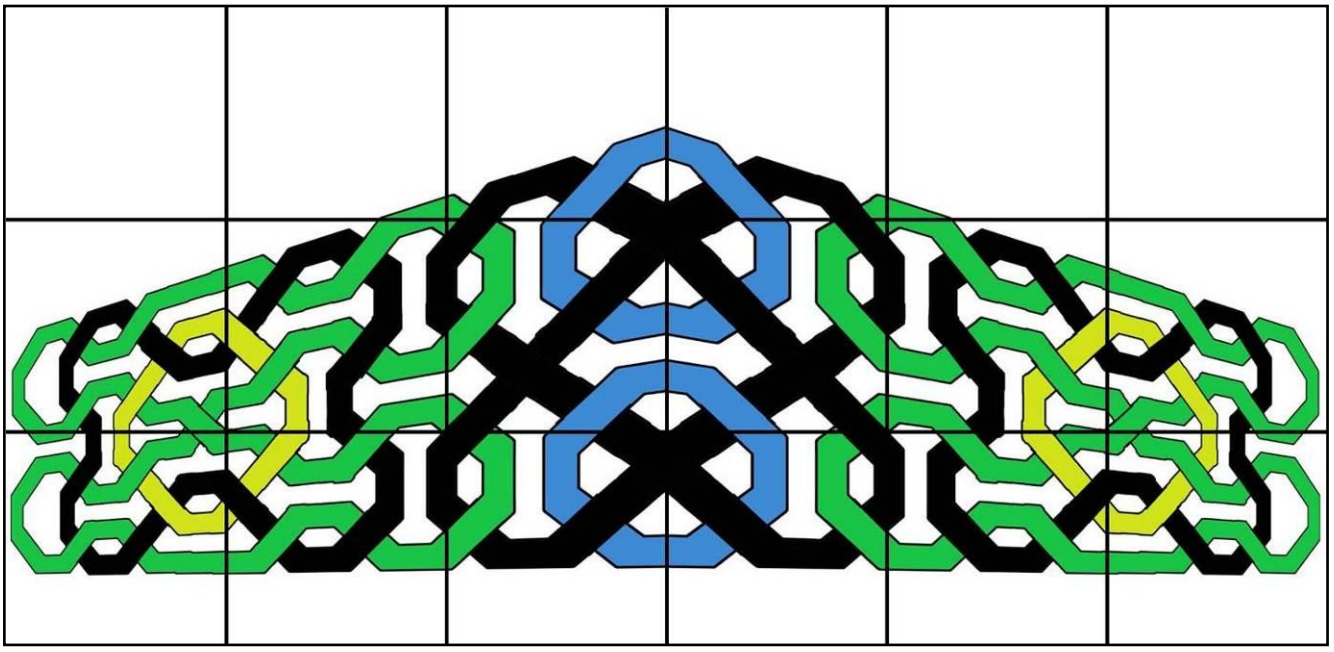




La deuxième partie, symétrique de la première se dessinera en retournant les gabarits.

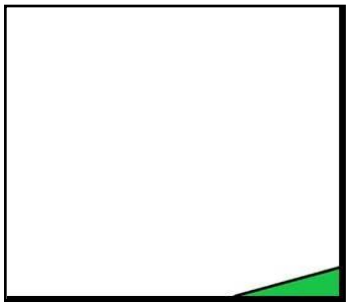


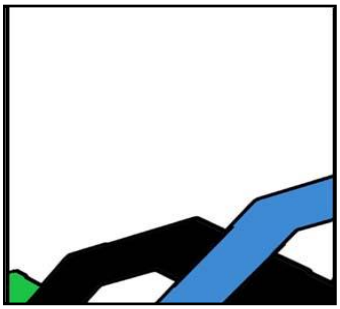
Dans ce projet, nous trouvons la frise simple et deux types de déformation de cette même frise : voir l'étude de ces déformations dans les pages suivantes.

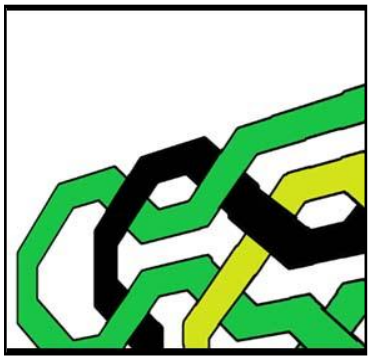


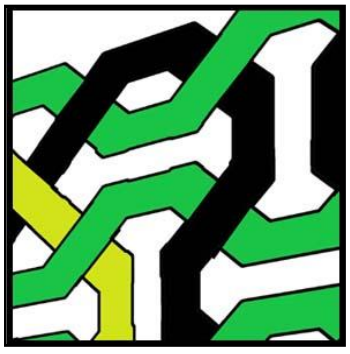
Utiliser l'option perspective pour une déformation du dessin.

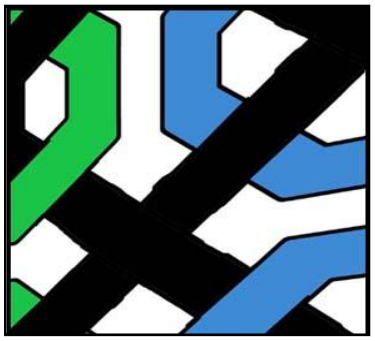
Gabarits destinés à être découpés pour un report du dessin : chaque zone est cadrée, enregistrée, et imprimée au format réel voulu.

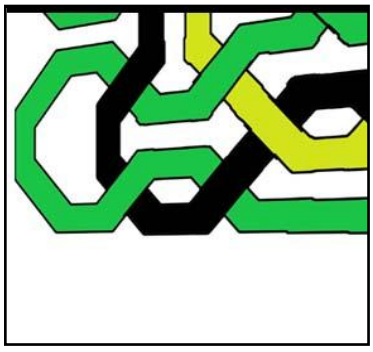


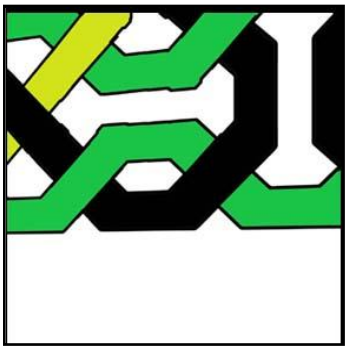


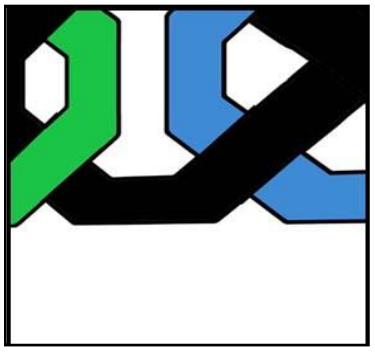


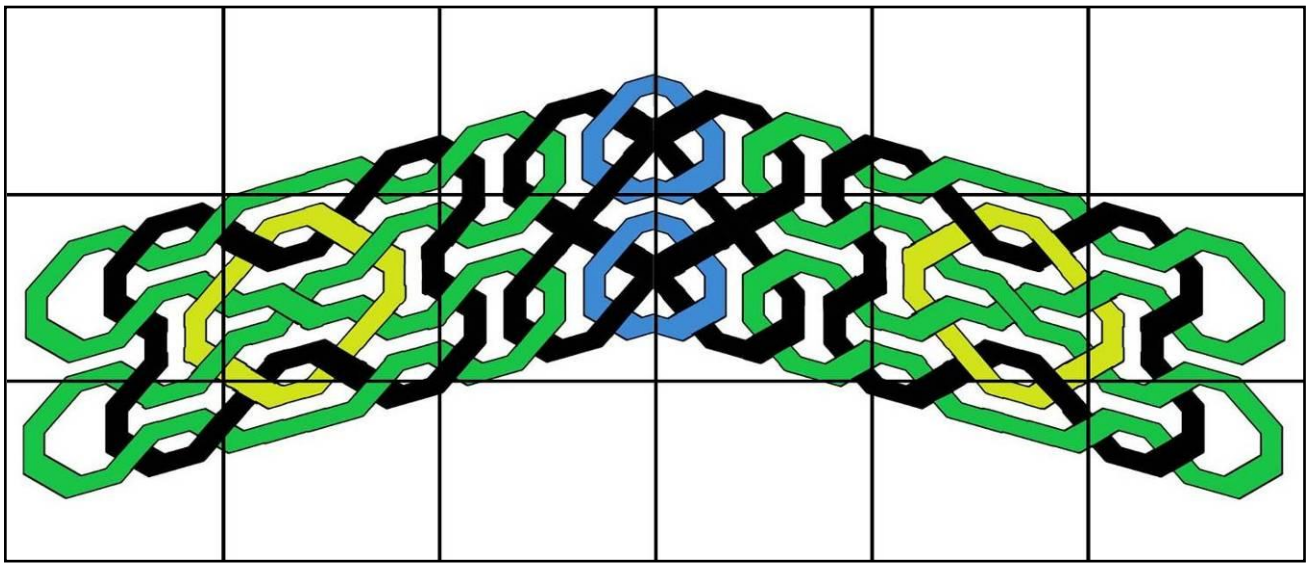




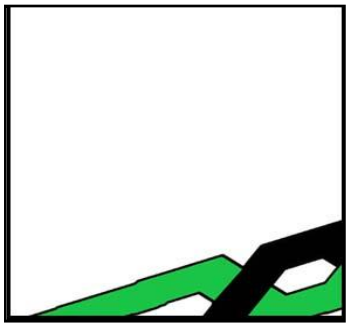


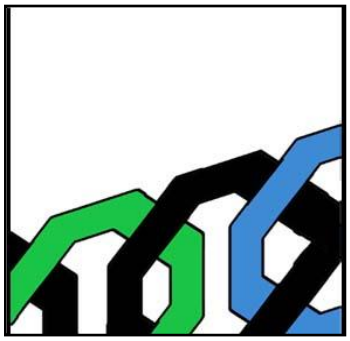


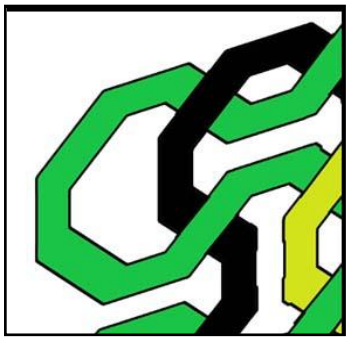


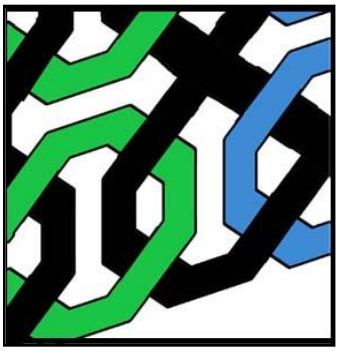


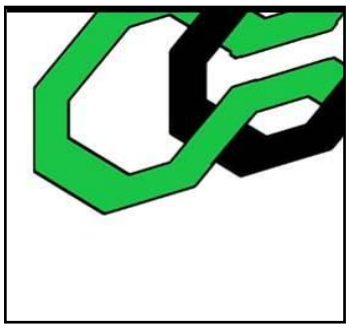
Déformation d'un motif en utilisant l'option perspective de Photoshop (**sélection** de la zone à déformer ; bandeau IMAGE, transformation, choix : **perspective**). Deux opérations : déformation de la partie droite et déformation identique de la partie gauche.







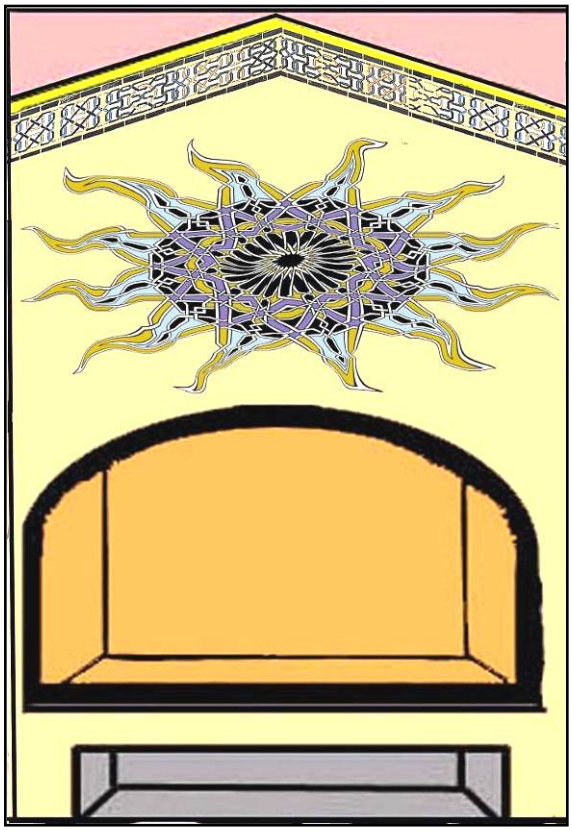




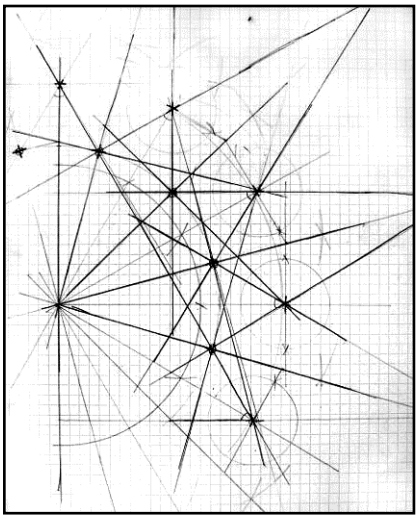
Pour le dessin de l'autre moitié, il suffit de retourner les gabarits précédents.

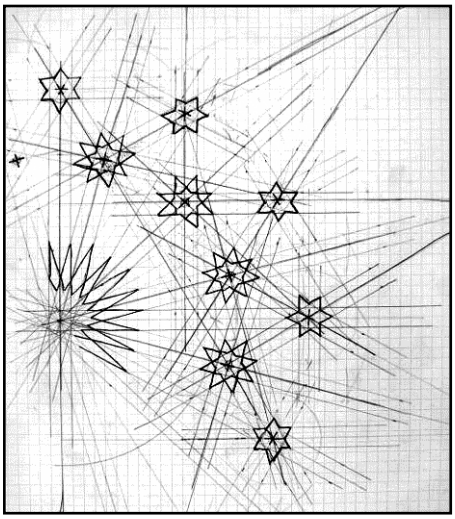
Utilisation de l’ordinateur pour interpréter un dessin, le déformer:

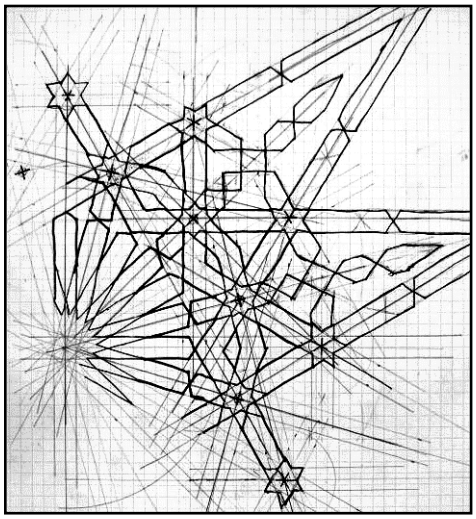
Soleil d’une fontaine du riad Loulou



Soleil déformé par ordinateur.





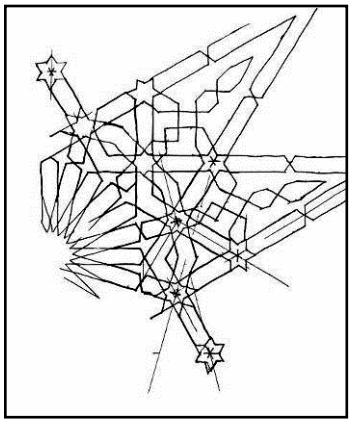


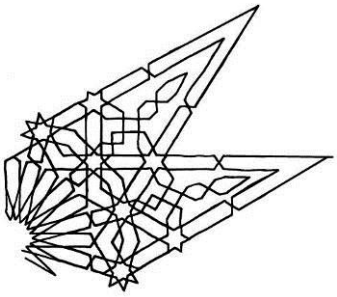
Dessin d’un système convergent avec au centre une étoile à vingt-quatre branches ayant une première couronne de satellites à huit et une deuxième à six. Le dessin final est scanné pour pouvoir l’interpréter sur l’ordinateur.

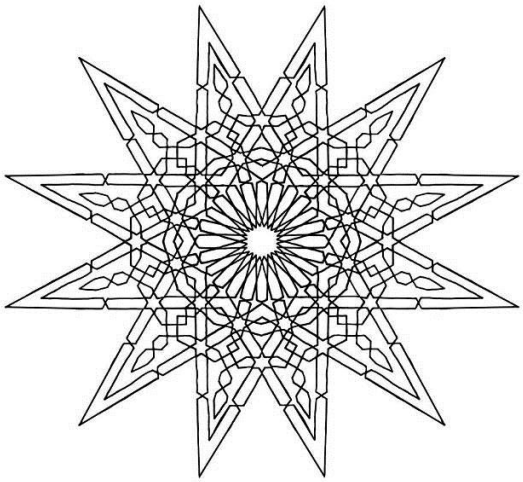
Dans un premier temps, il faut isoler le trait, le nettoyer, le compléter et ensuite reconstituer le dessin entier en utilisant les différentes symétries.

PHOTOGRAPHIES

DIAPORAMA

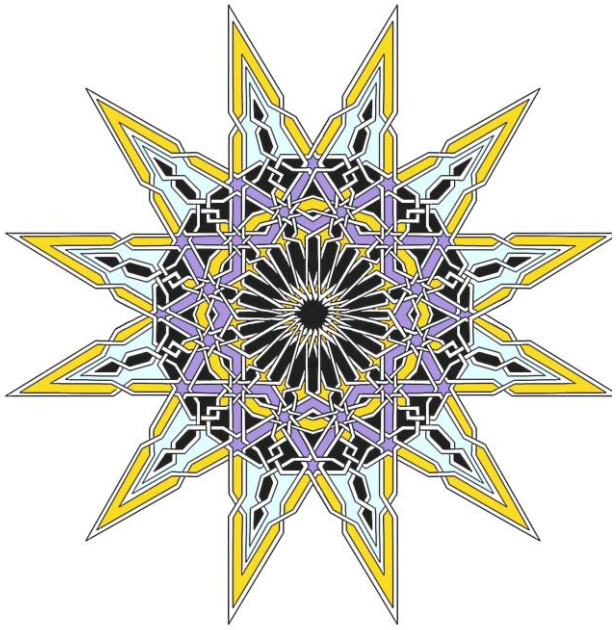


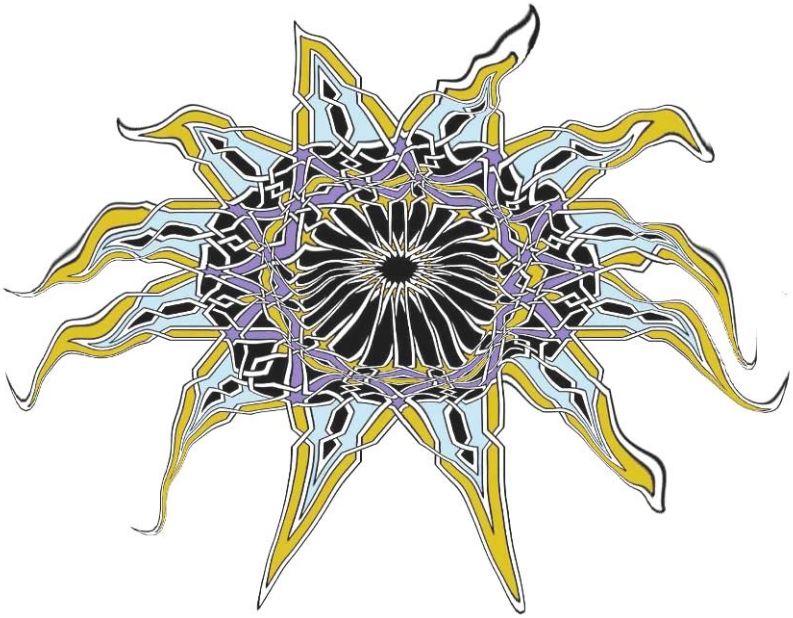


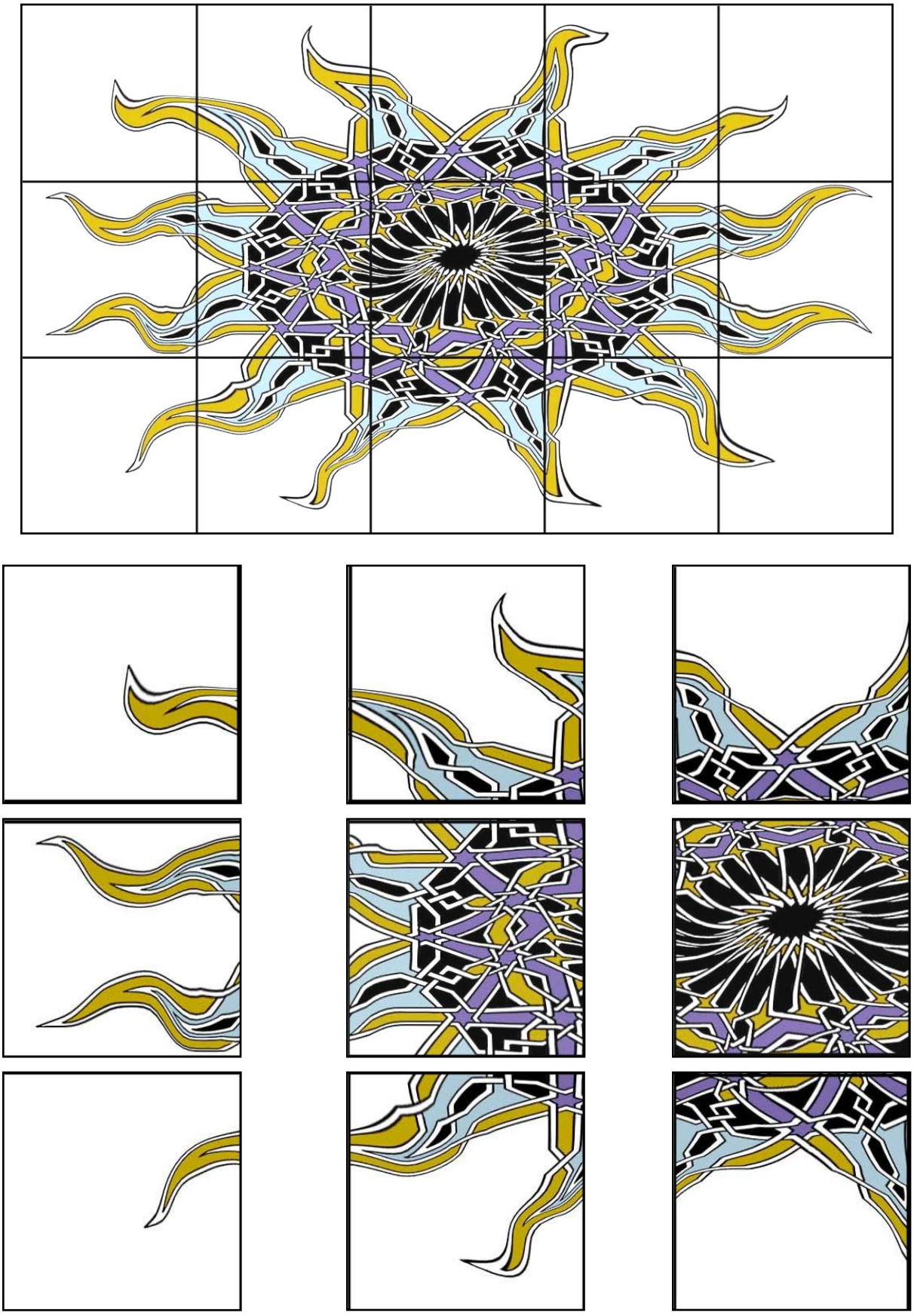


Accentuation du dessin (ACCENTUATION : **luminosité contraste**) ; sélection du trait (OPTIONS : **baguette magique**) ; inversion de la sélection (SELECTION : **interverser**) ; nettoyer les pixels (EDITION : **couper**) ; nettoyage et réfection de certains traits (OPTION : **gomme** et **trait**). Après l'usage du trait ne pas oublier d'aplatir l'image car chaque trait crée un calque supplémentaire.

Rotations et symétries axiales (IMAGE, **rotation**, **symétrie d'axe horizontal** et **vertical**) combinées permettent de reconstituer le dessin. Entre chaque transformation il est nécessaire de réajuster les alignements en utilisant la grille avec l'option perspective pour faire coïncider les transformations (IMAGE, **transformation**, **perspective**). Traçage des entrelacs comme précédemment.

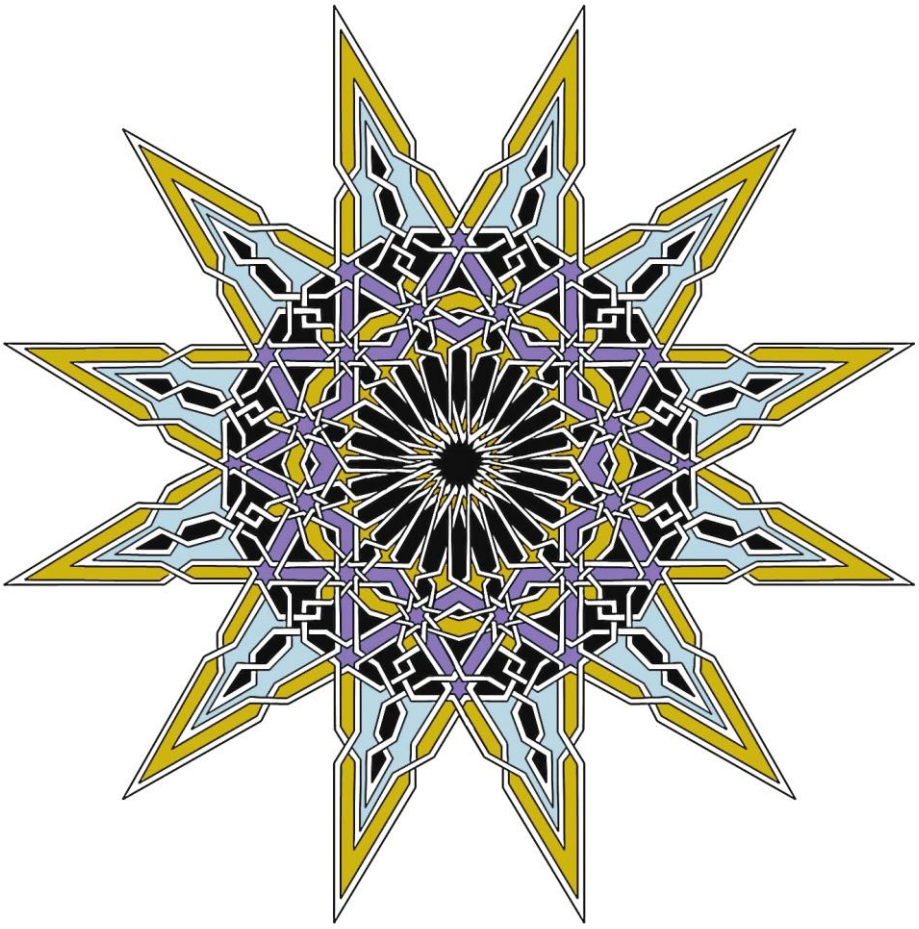


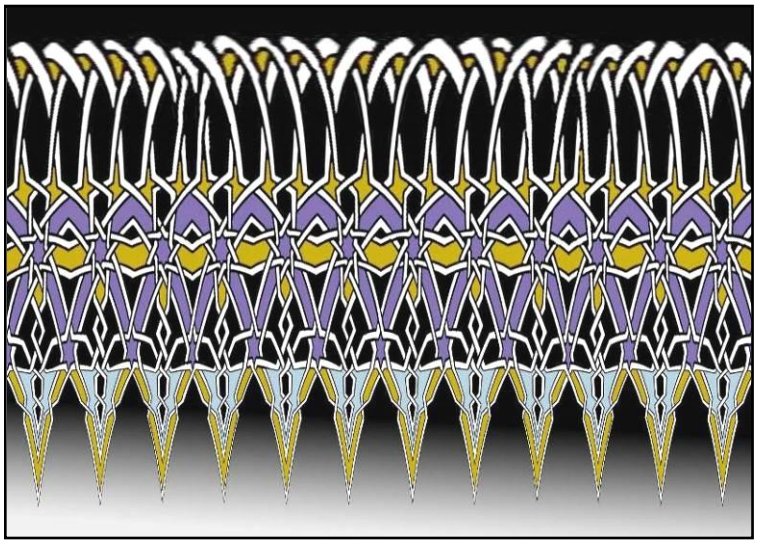


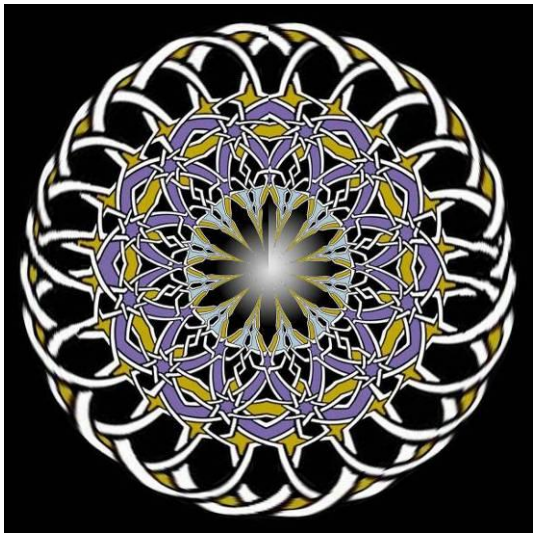


Dessin d’une partie des carreaux destinés à être reportés sur un autre support.

Transformation de cette arabesque par l'ordinateur : utilisation des filtres de Photoshop.

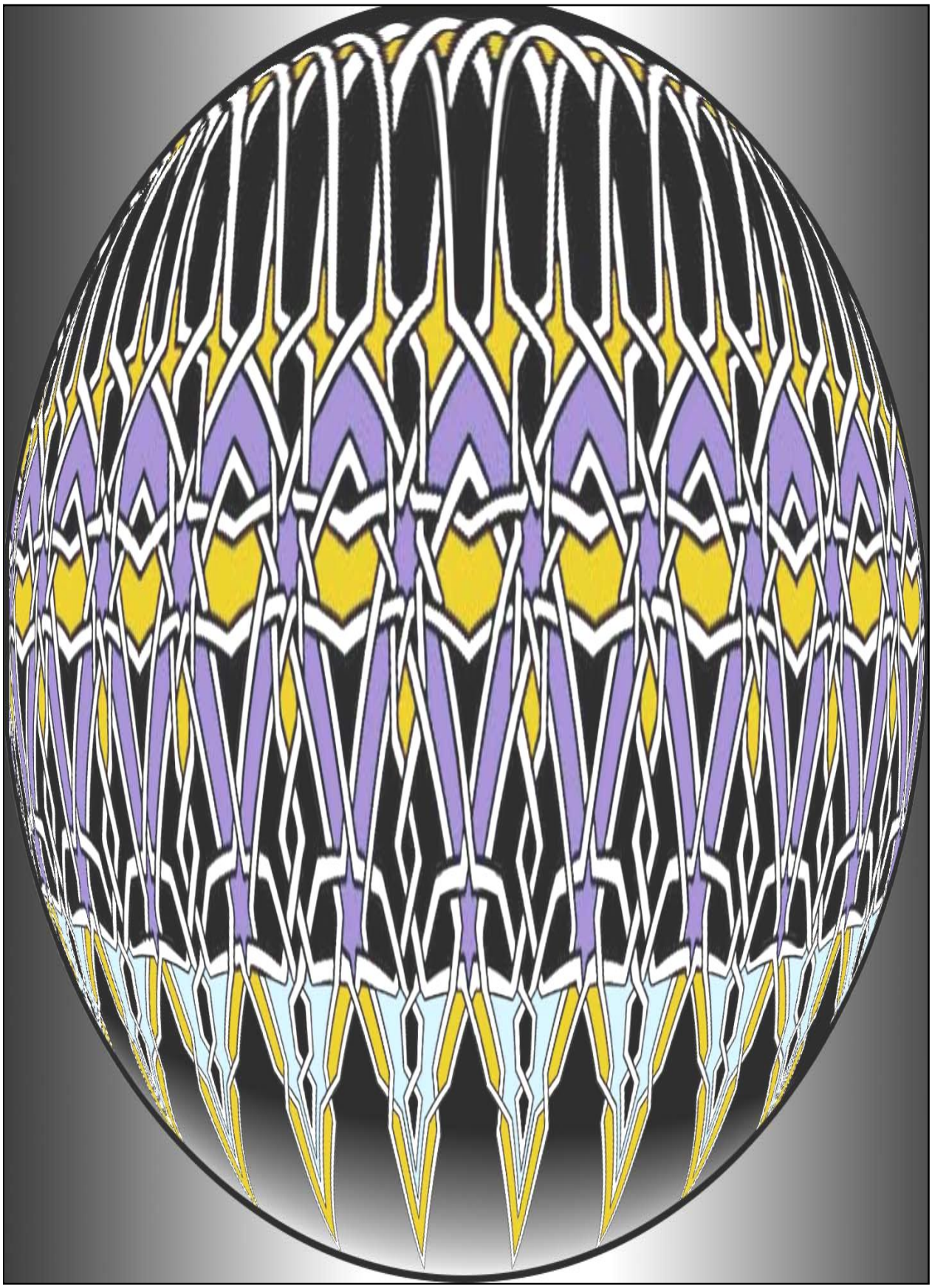






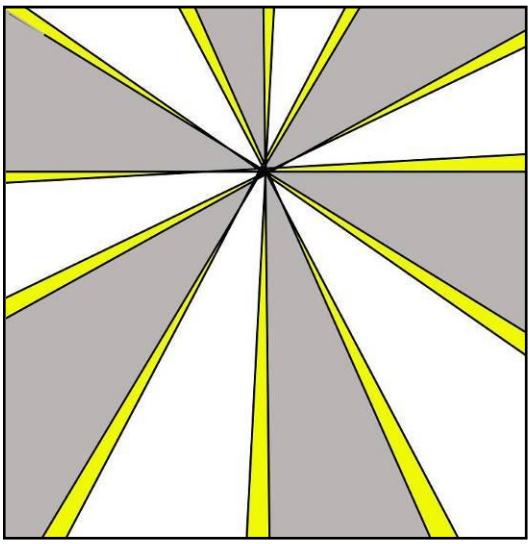
L'utilisation du filtre COORDONNEES POLAIRES permet de changer une droite en un cercle ; il est utilisé ici pour transformer la rosace en une frise.

Le même changement de coordonnées appliqué sur la frise précédente (filtre rectangle en polaire, après une **symétrie verticale de la zone de travail**) permet d'obtenir la rosace différente ci-contre.

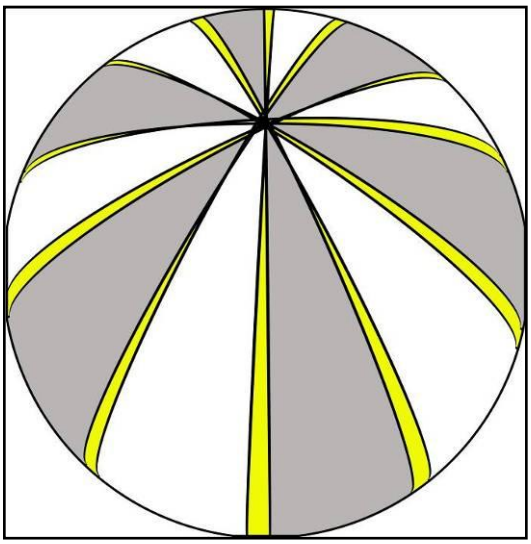


PHOTOGRAPHIES DIAPORAMA

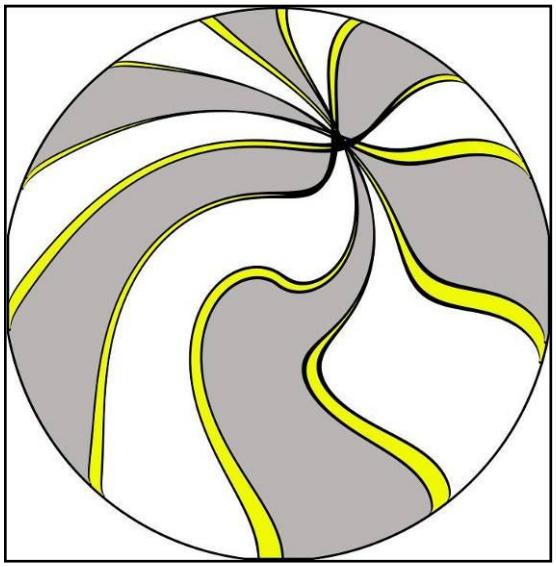
Autre exemple de construction.



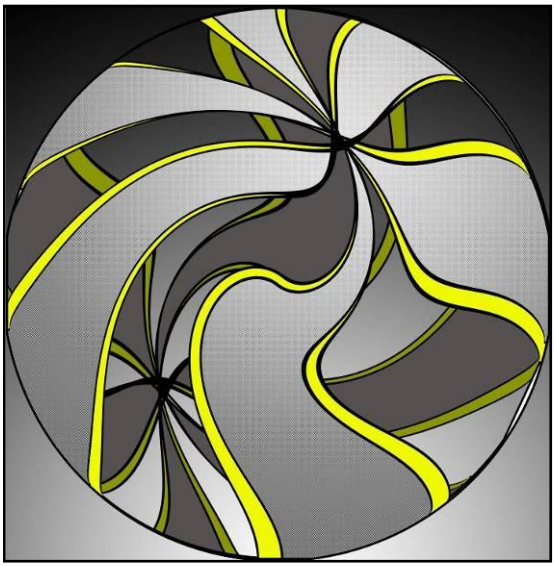
Dessin de base



Sphérisation, nettoyage du tour. Traçage du contour.



Tourbillon.
Copie du calque et travail sur cette copie.
Rotation à180°.
Tourbillon en sens contraire.
Sélection de la **partie dessinée** avec les traits ; l'assombrir, inverser la sélection et **couper** le reste.
Travail sur le **calque fond** : travailler sur une copie ; sélectionner le dessin et les traits ; inverser la sélection et couper.

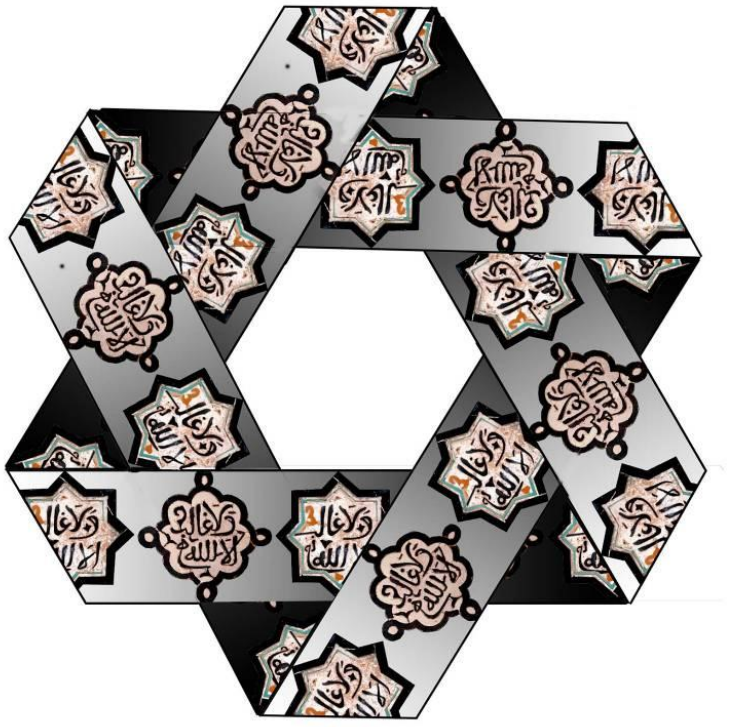


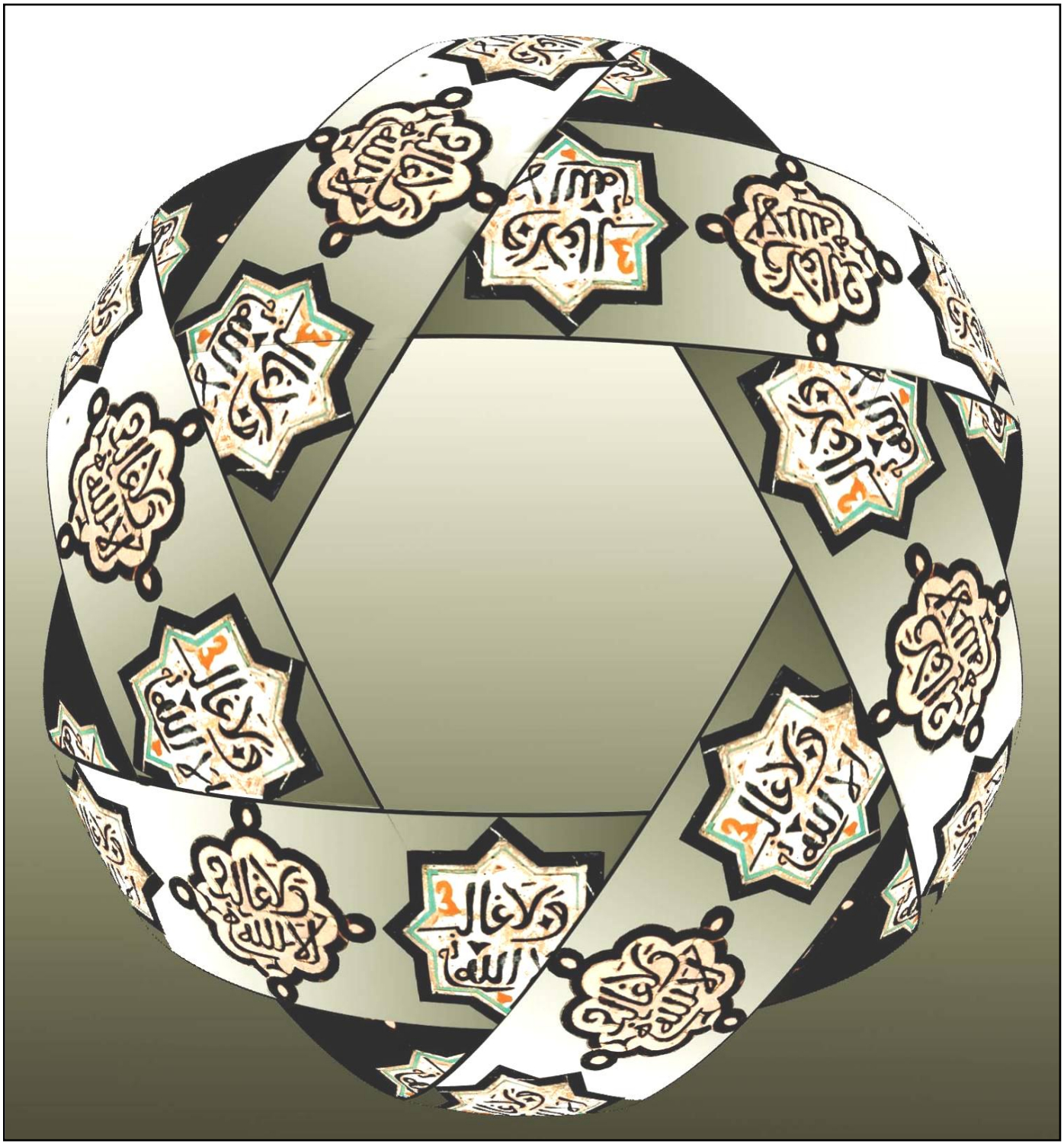
Placer les deux calques correctement (l'un devant, l'autre derrière).
Aplatir, placer le fond à sa convenance et ombrer les parties claires de devant sur le pourtour.

Confection de l’anneau de Moebius.

Choix des éléments et construction de la frise.

Construction et ombrage du module. Placement des trois modules et sphérisation. Doublage par rotation.





Sphérisation.
Choix d’un dégradé de fond.

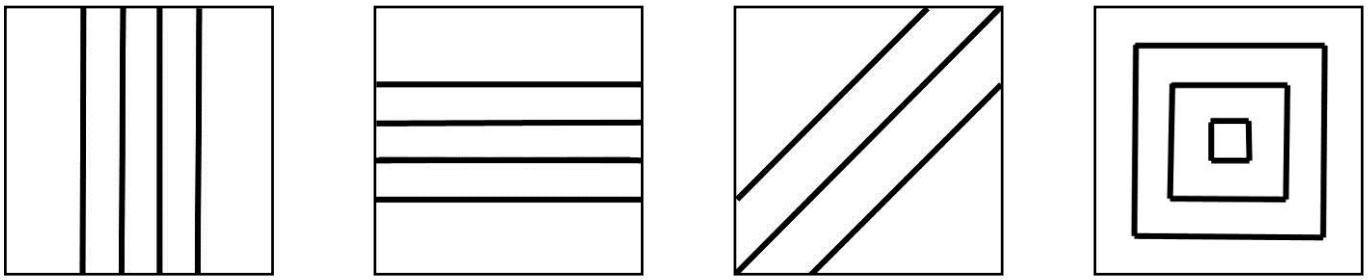
Choix d’un fond.
Composition de quatre anneaux

PHOTOGRAPHIES DIAPORAMA

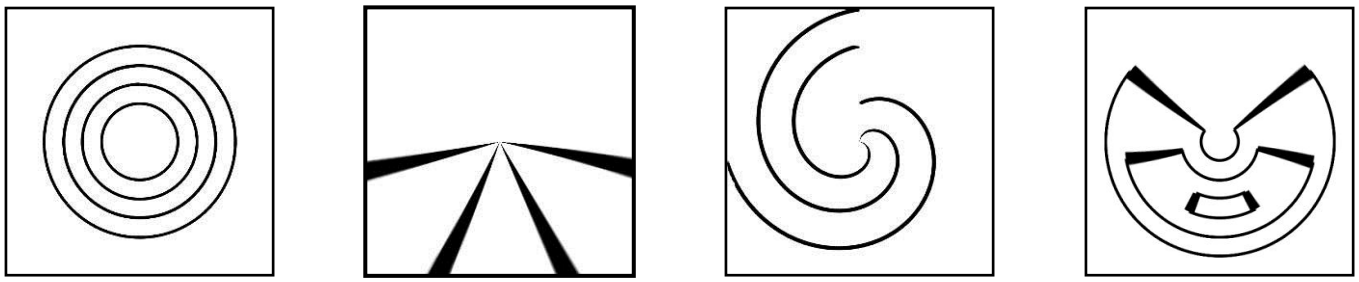
FILTRE COORDONNEES POLAIRES.

Cette transformation présente des effets si surprenants qu'elle mérite une attention particulière. Elle transforme une droite horizontale en un cercle, les droites parallèles verticales en des cercles concentriques. En transformant une rosace, on obtient une frise et vice-versa.

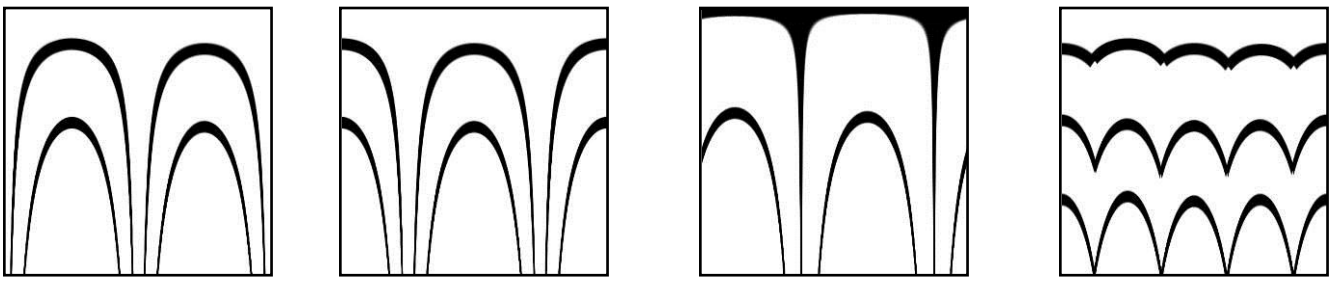
Motif initial.



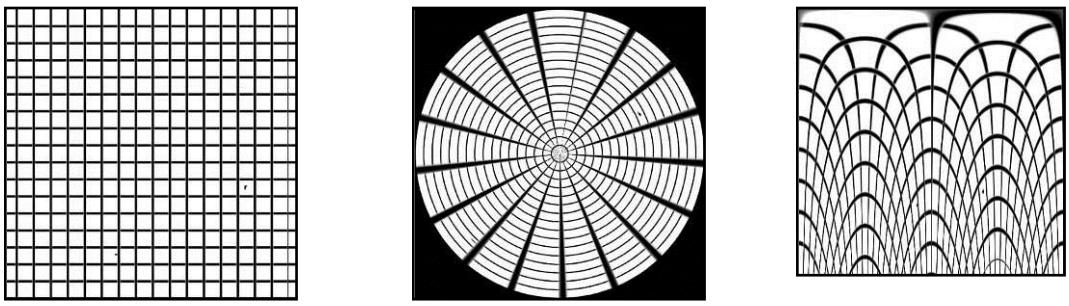
Filtre COORDONNEES POLAIRES (rectangulaire en polaire).



Filtre COORDONNEES POLAIRES (polaire en rectangle)

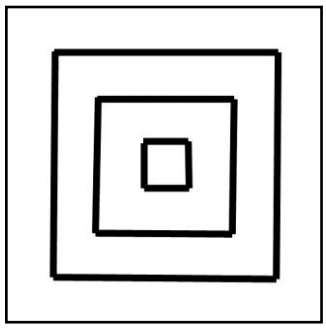


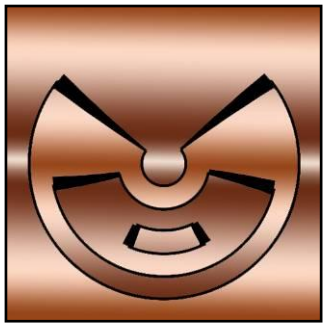
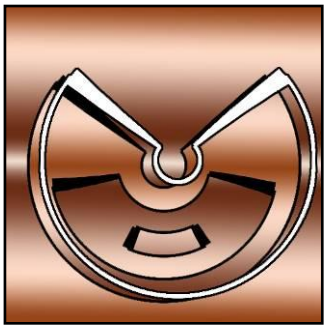
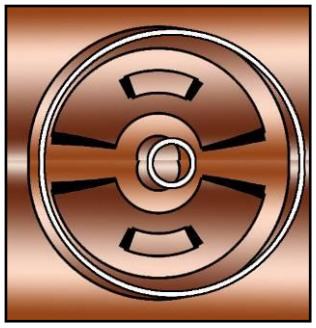
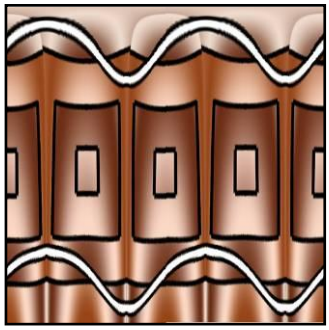
Pavages.



RETOUR

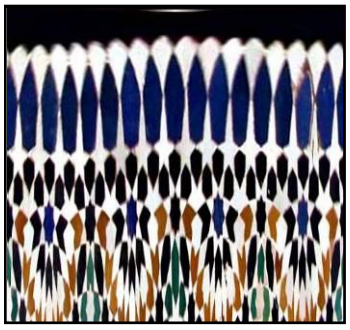
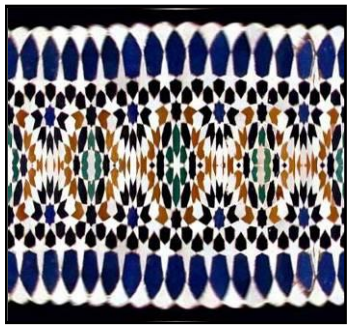
Exemple de construction simple :



Original. Rectangulaire en polaire. Dégradés. Sélection du trait noir, déplacement de cette sélection, couper, resélectionner, contour de cette sélection. Sélectionner une demi-figure, copier, coller, symétrie d'axe vertical, déplacer, aplatir. Polaire en rectangulaire pour faire apparaître la frise.

Autres exemples : zelliges marocaines.

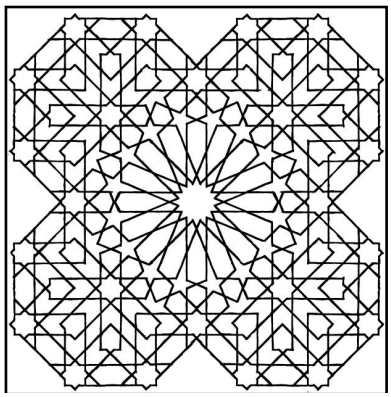
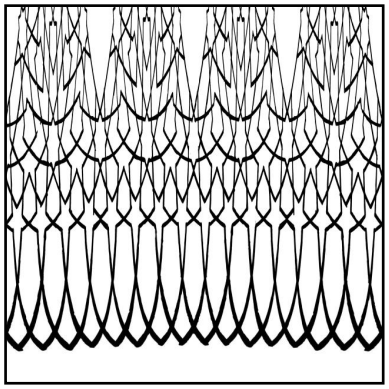
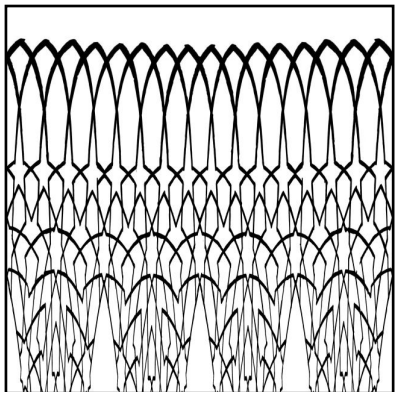



Transformation de la rosace (feuille de trèfle) en frise en utilisant le filtre COORDONNEES POLAIRES (polaire en rectangulaire).

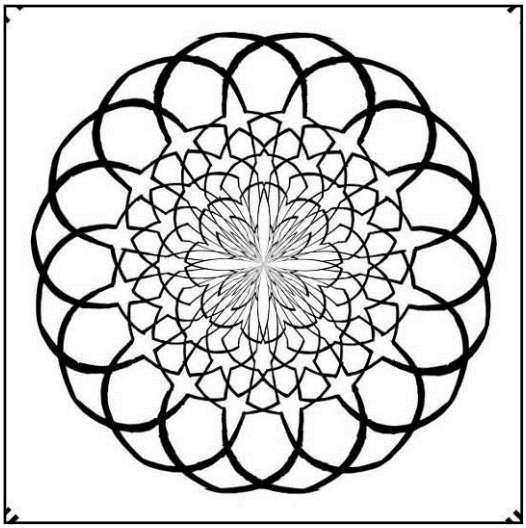
Sélection totale, transformation manuelle de cette sélection, copier, coller, symétrie d'axe vertical, déplacement et ajustements.

Transformation de cette double frise en rosace : filtre COORDONNEES POLAIRES (rectangulaire en polaire).

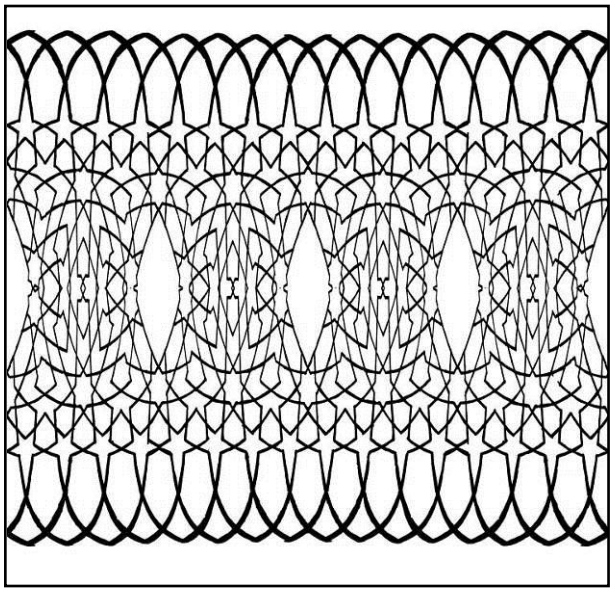
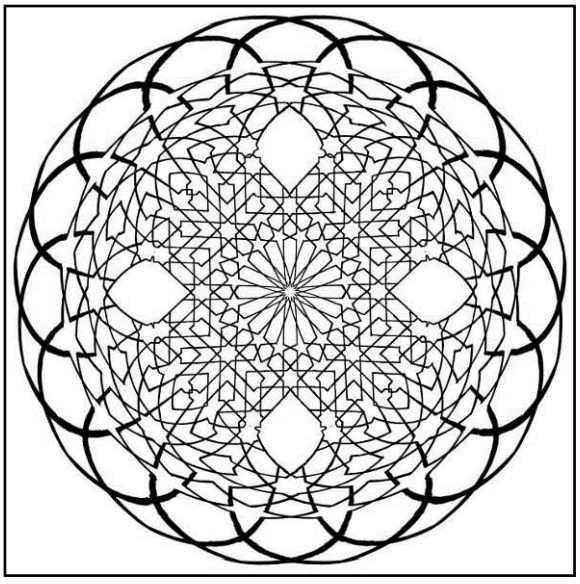
Reprise du même exemple dessiné :

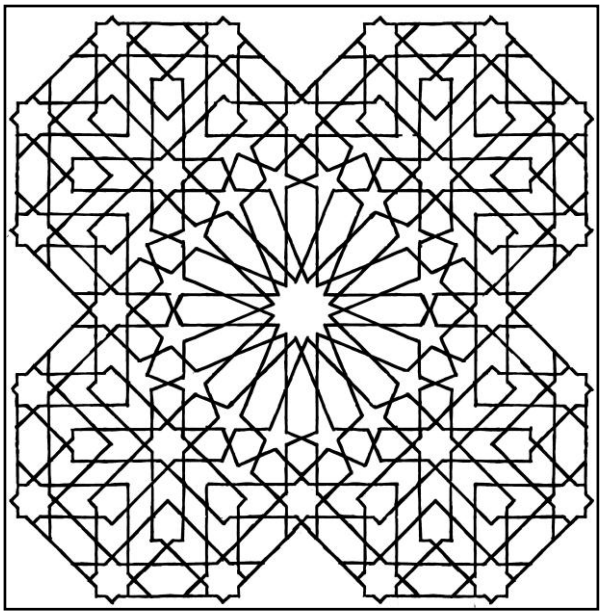




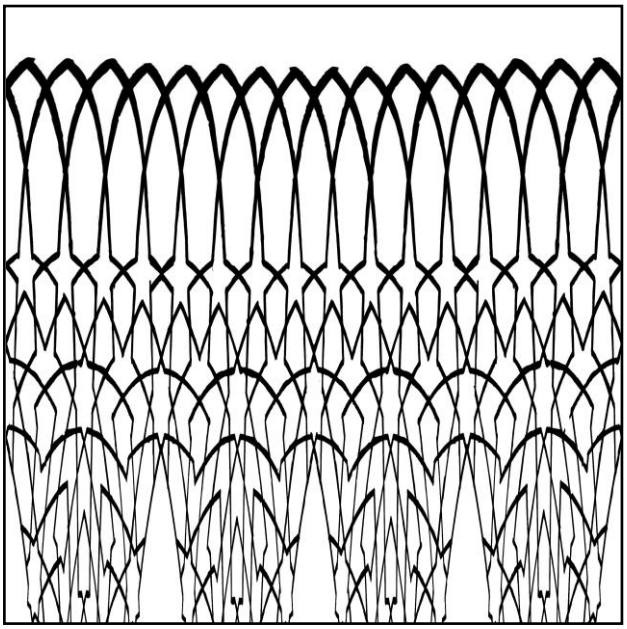
Dessin de la feuille de trèfle précédente ; filtre COORDONNEES POLAIRE (polaire en rectangle) ; sélection totale et symétrie verticale ; filtre COORDONNEES POLAIRE (rectangle en polaire).



Doublage vertical de la frise précédente ; filtre COORDONNEES POLAIRE (rectangle en polaire).

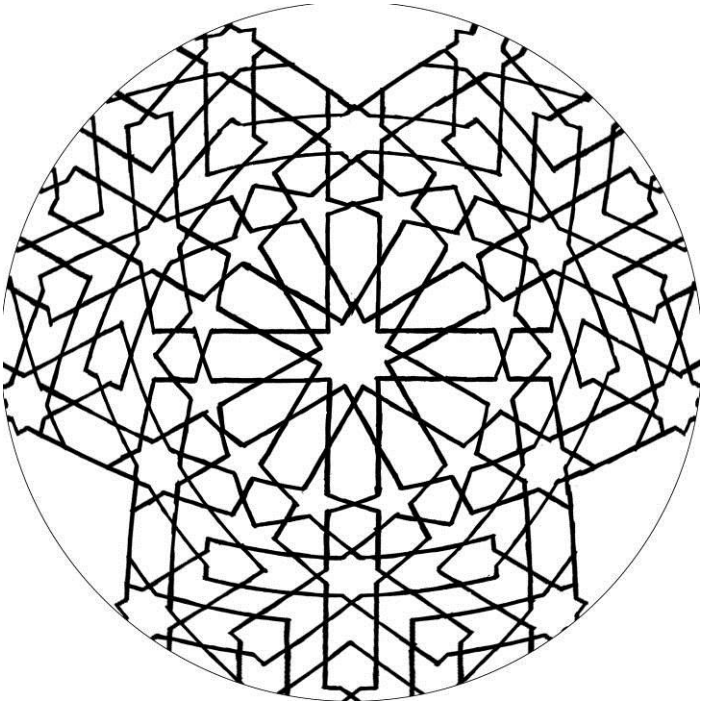



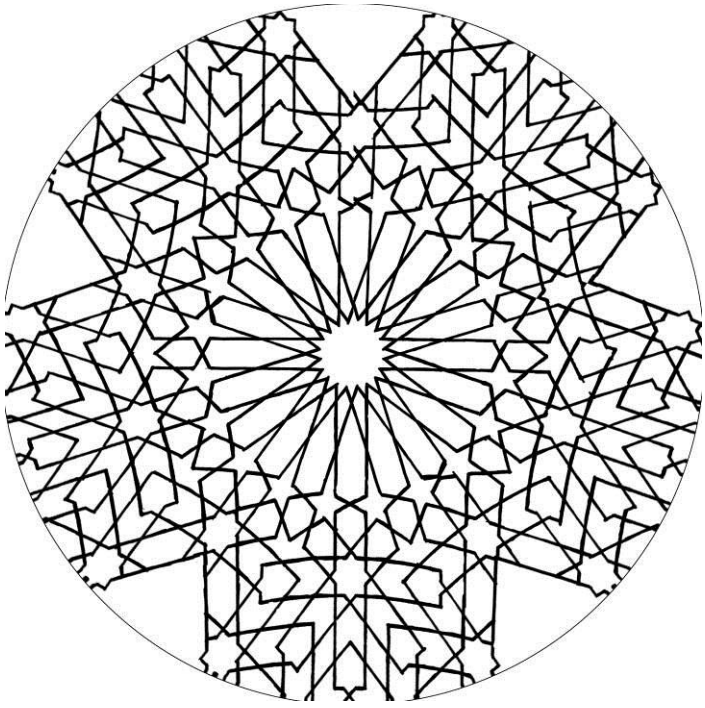




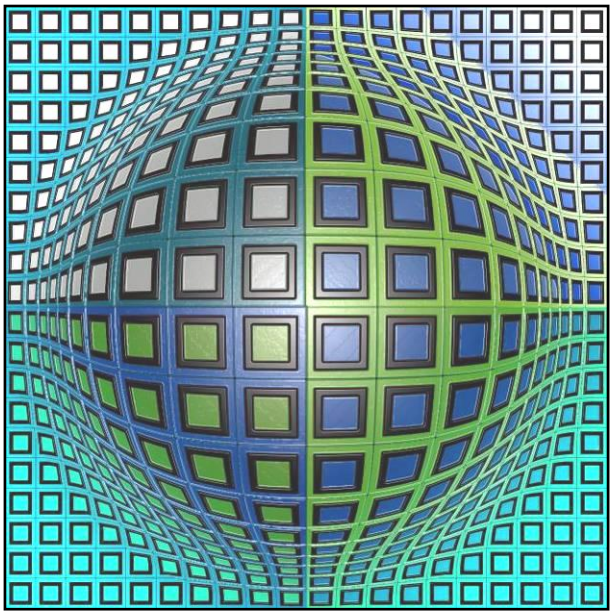
Pour changer le nombre de branches d'une étoile : l'étoile d'origine dans le cas considéré possède 16 branches.

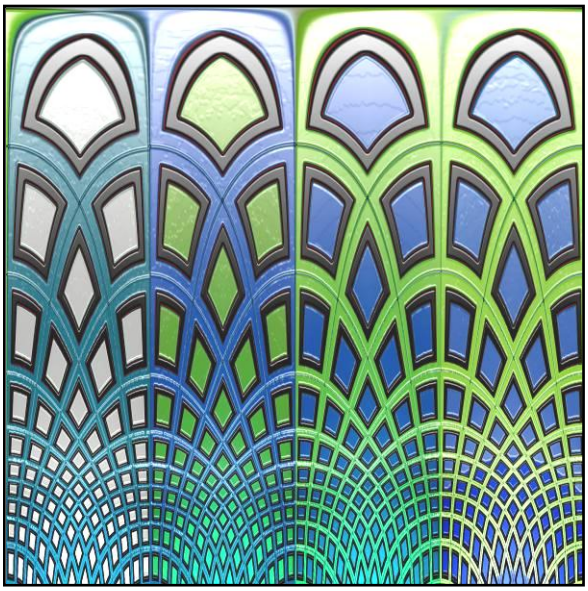
Filtre COORDONEES POLAIRE (polaire en rectangle) ; remarquer les quatre parties symétrique du résultat ; supprimer une partie donnera une étoile à 12 branches. Pour obtenir l'étoile à 20 branches, il suffit de rajouter une partie. Terminer dans chaque cas par le filtre COORDONNEES POLAIRE (rectangulaire en polaire).

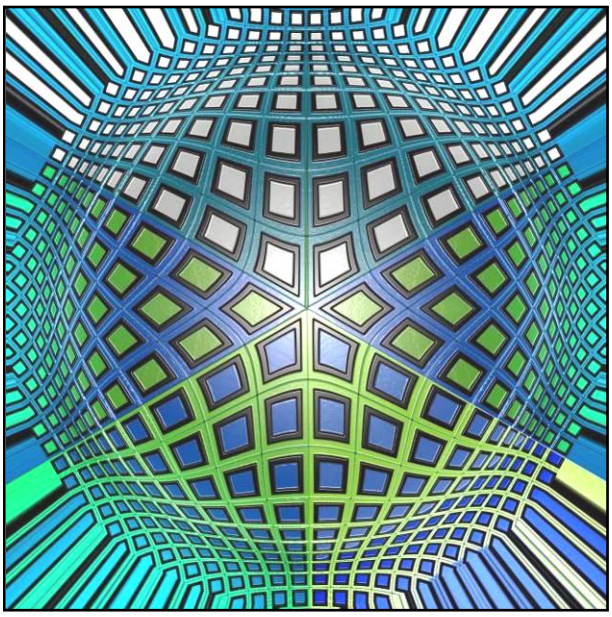


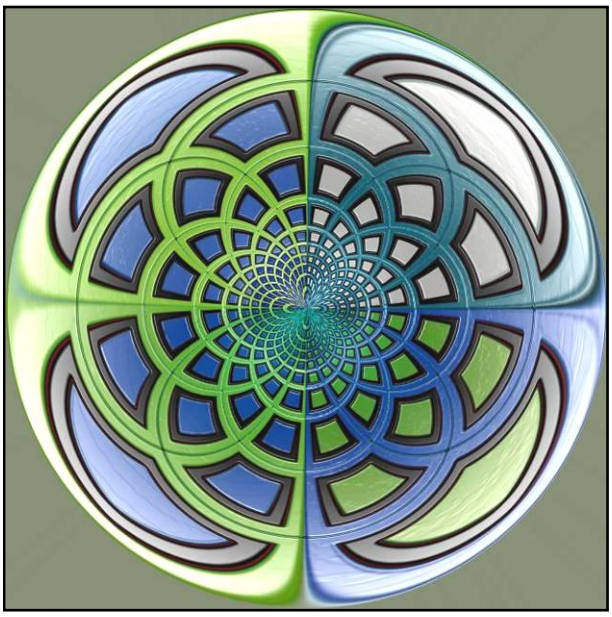


Autres exemples :



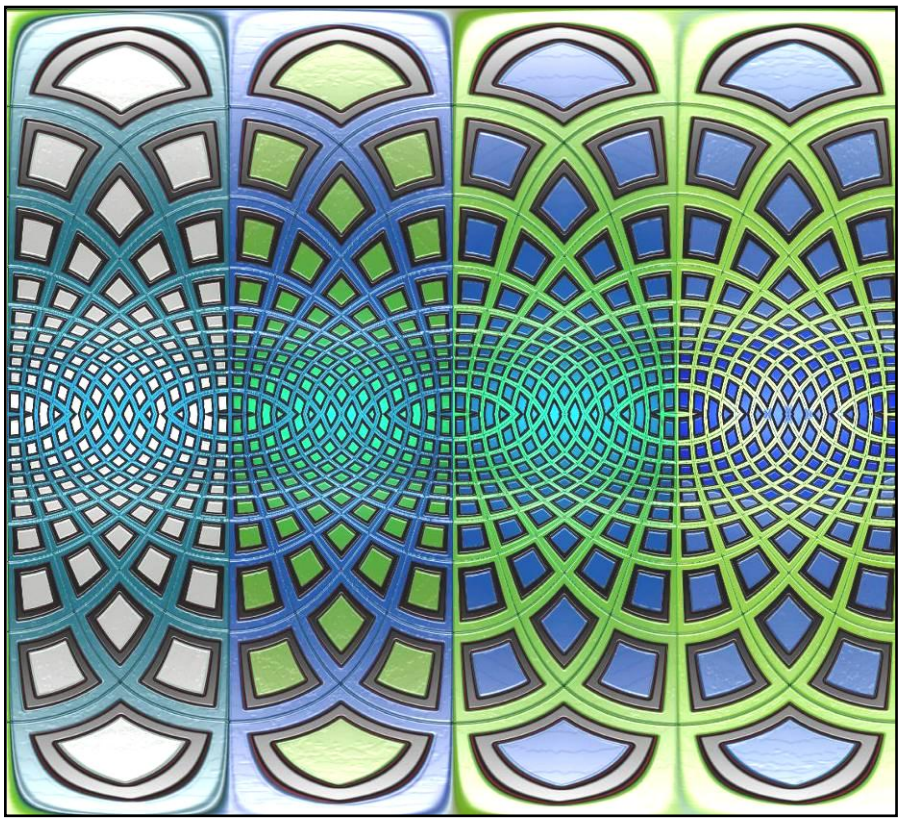


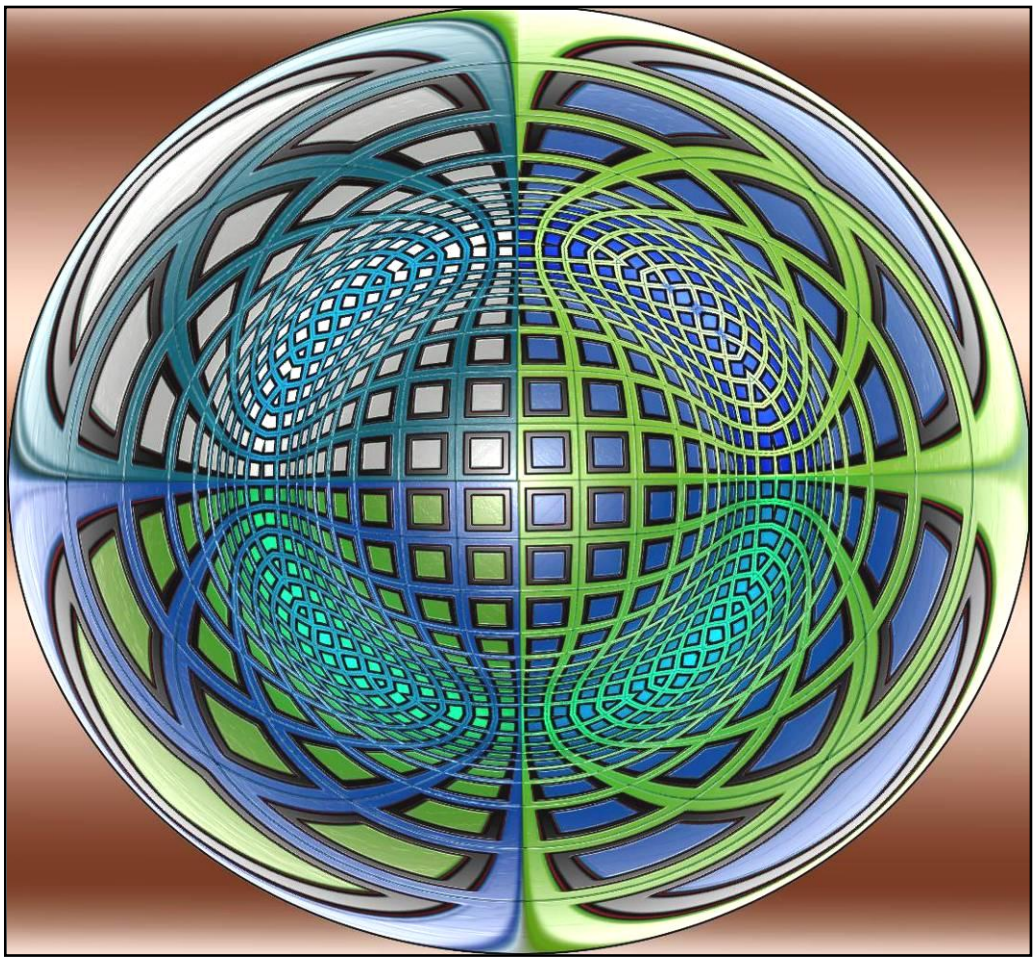




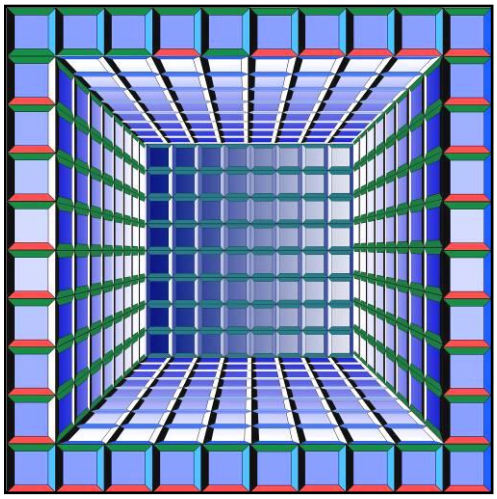
Au dessus : transformation polaire, rajout d'un élément et retransformation polaire inverse pour obtenir la figure formée de trois axes de symétrie.

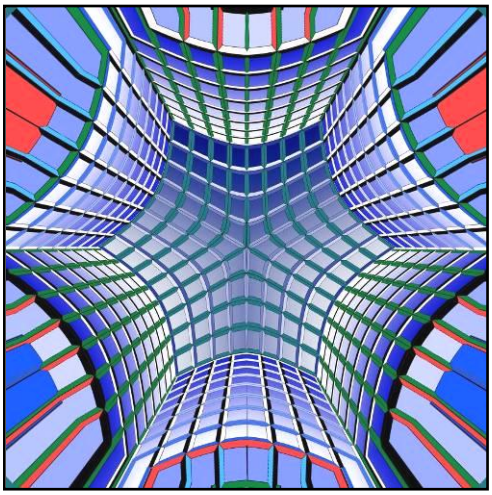
Symétrie verticale de la transformation polaire précédente (polaire en rectangle) et retransformation polaire inverse (rectangulaire en polaire).

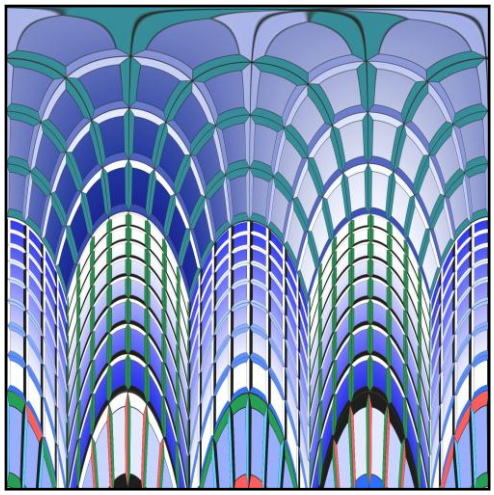




CONSTRUCTION







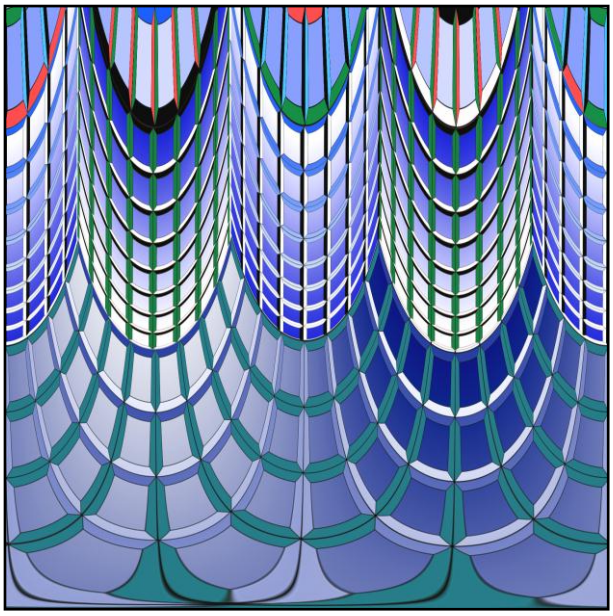
Polaire en rectangle, symétrie verticale, rectangle en polaire.

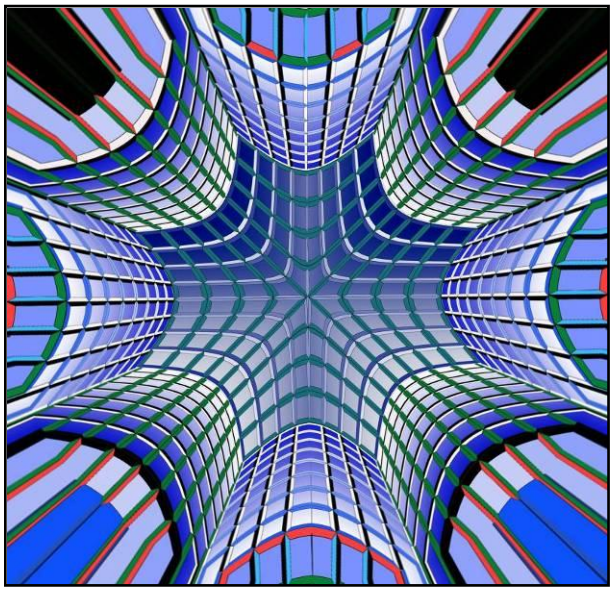
Rajout de deux éléments de symétrie pour obtenir un hexagone

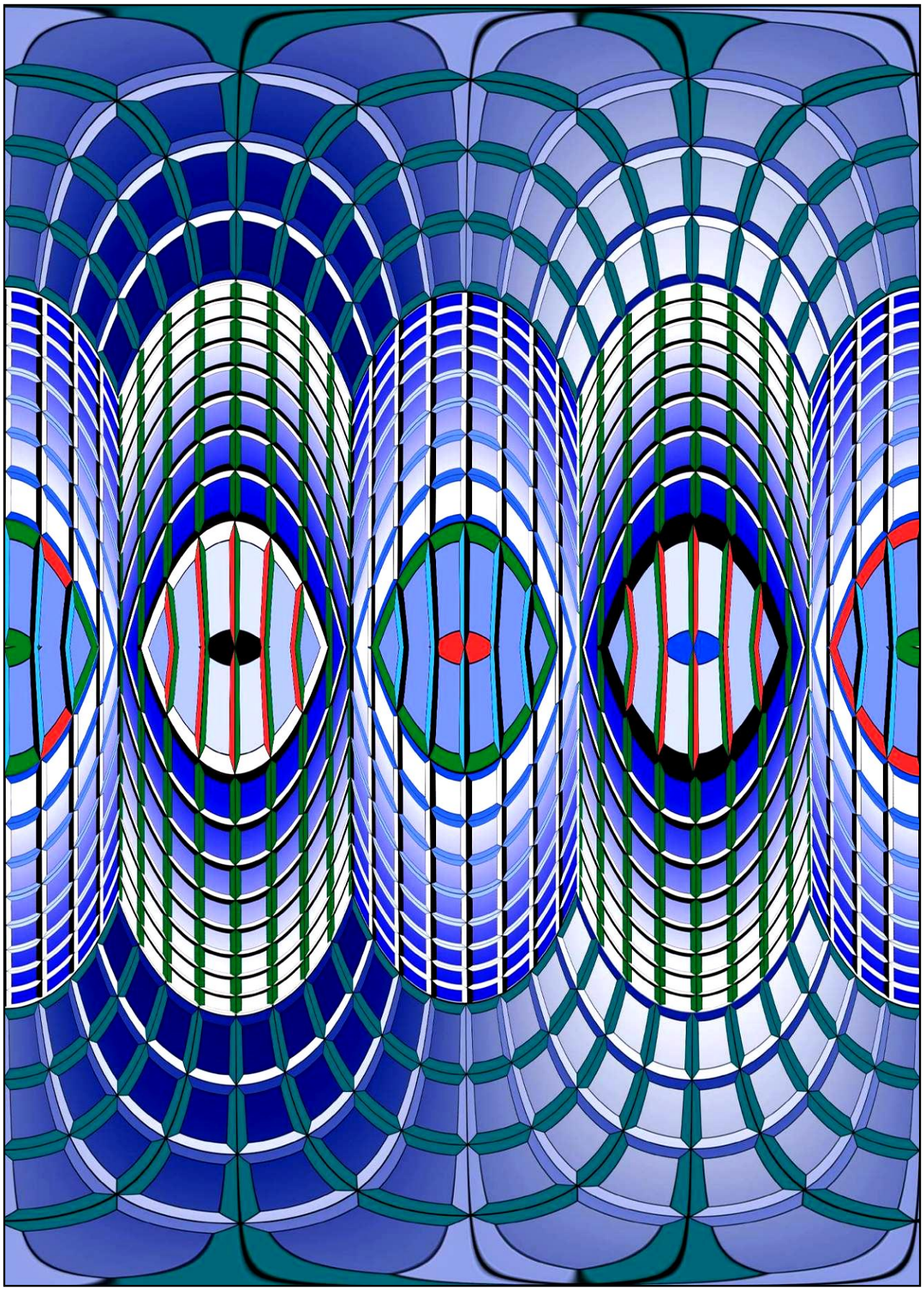
Rajout de quatre éléments de symétrie pour obtenir un octogone.

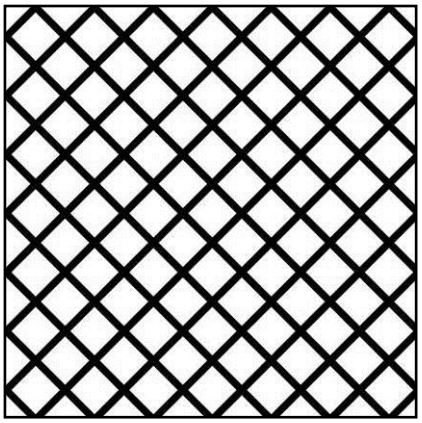
Remarque :

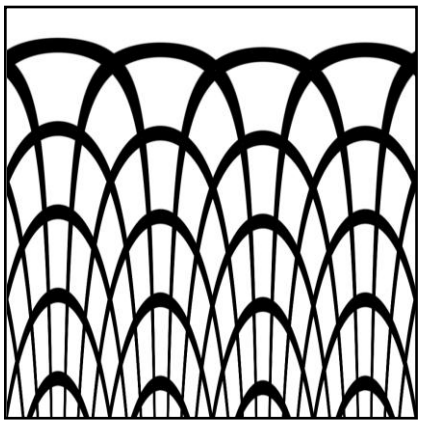
Les transformations polaires sont *polarisées ;* c'est-à-dire que pour chaque orientation de la figure source, on obtient une image différente.

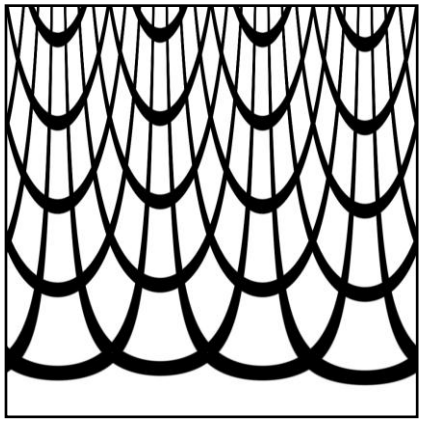


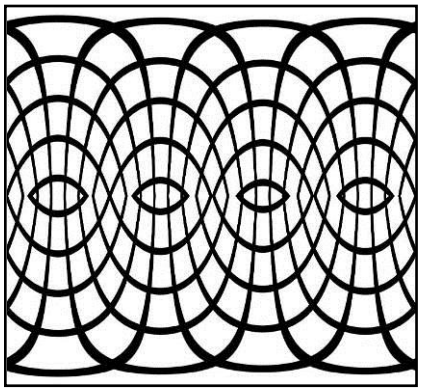


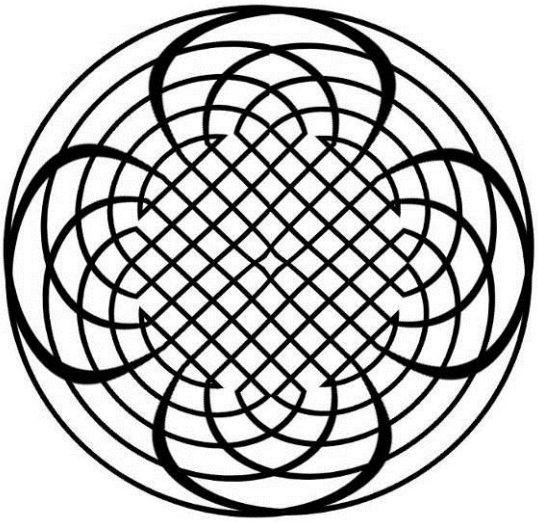


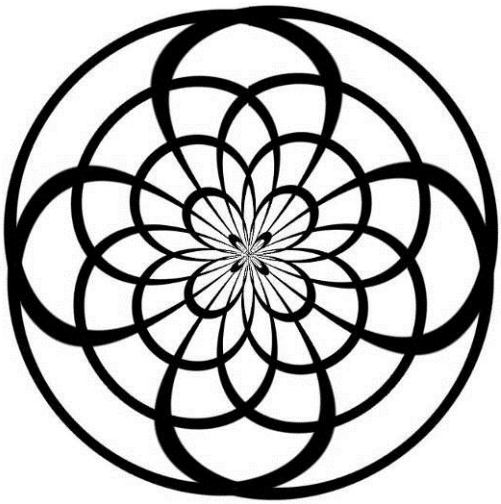


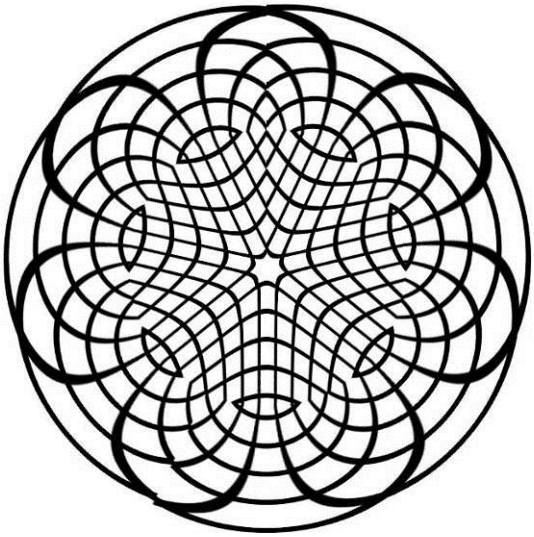


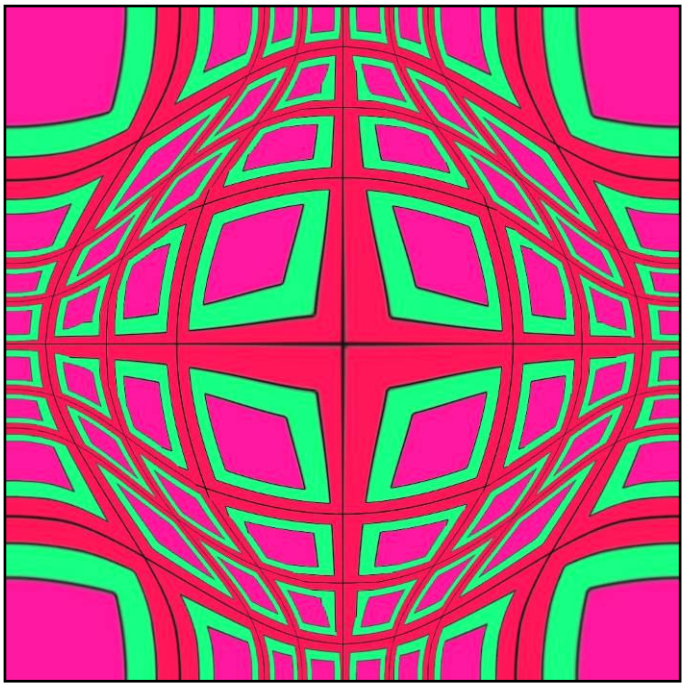


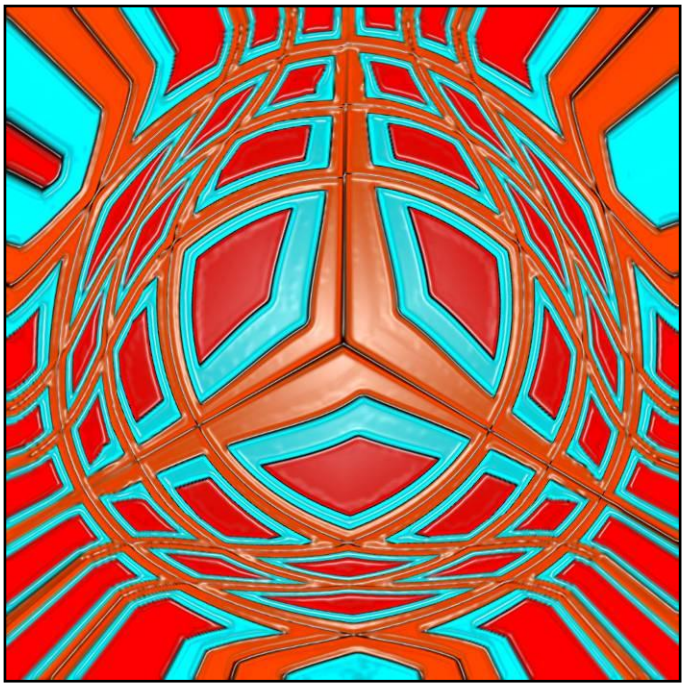


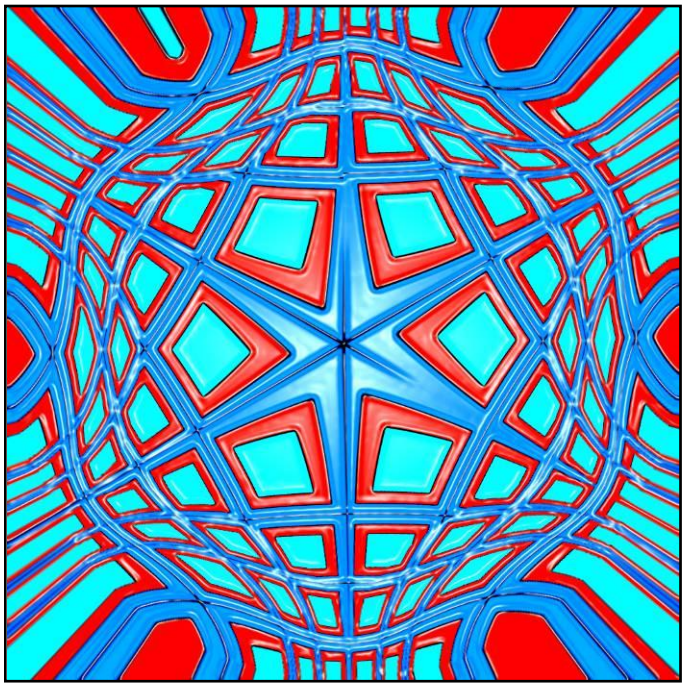


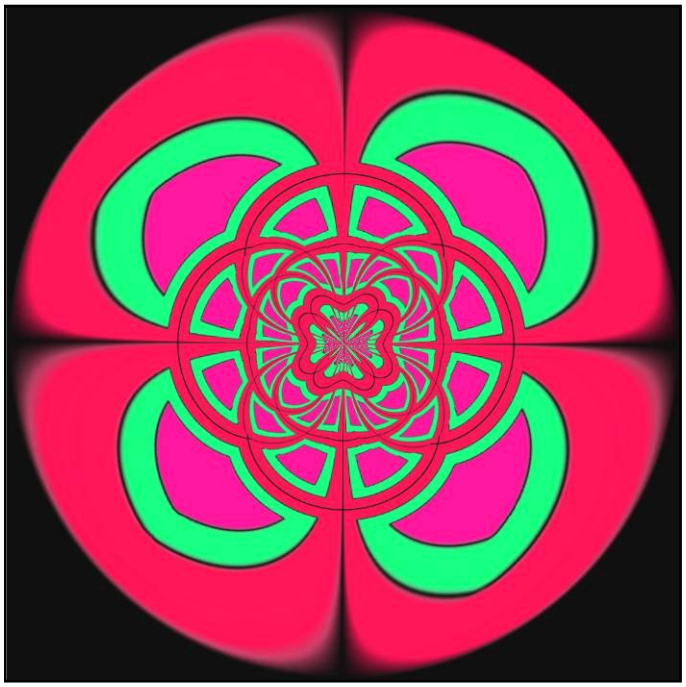




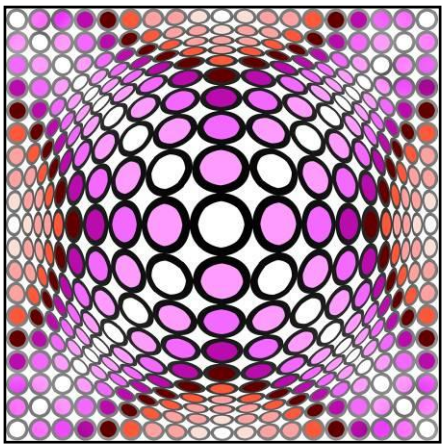


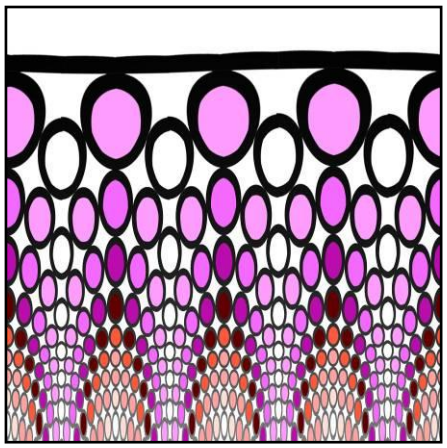


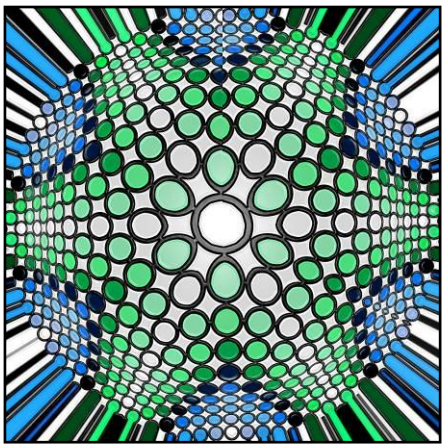


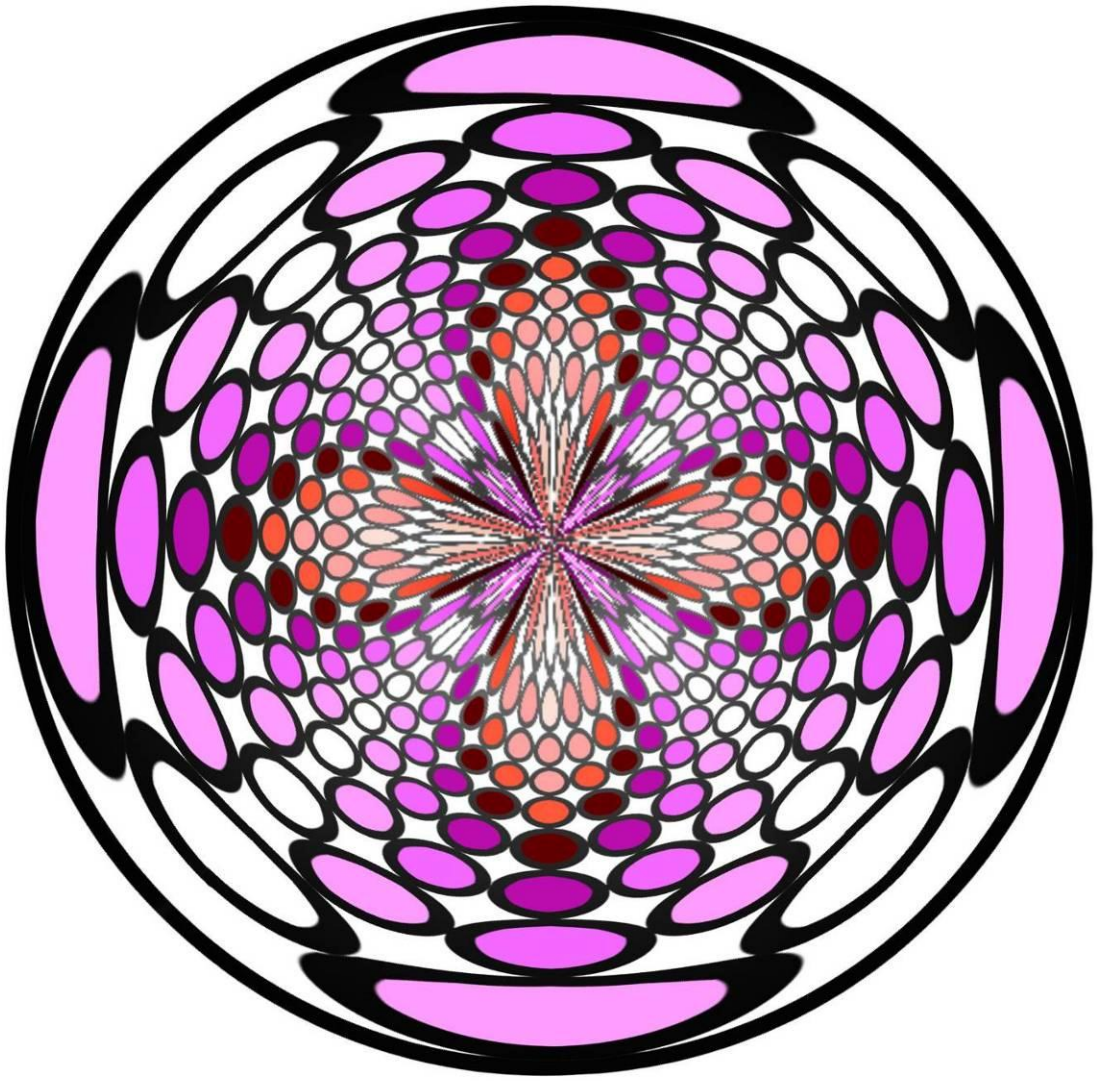


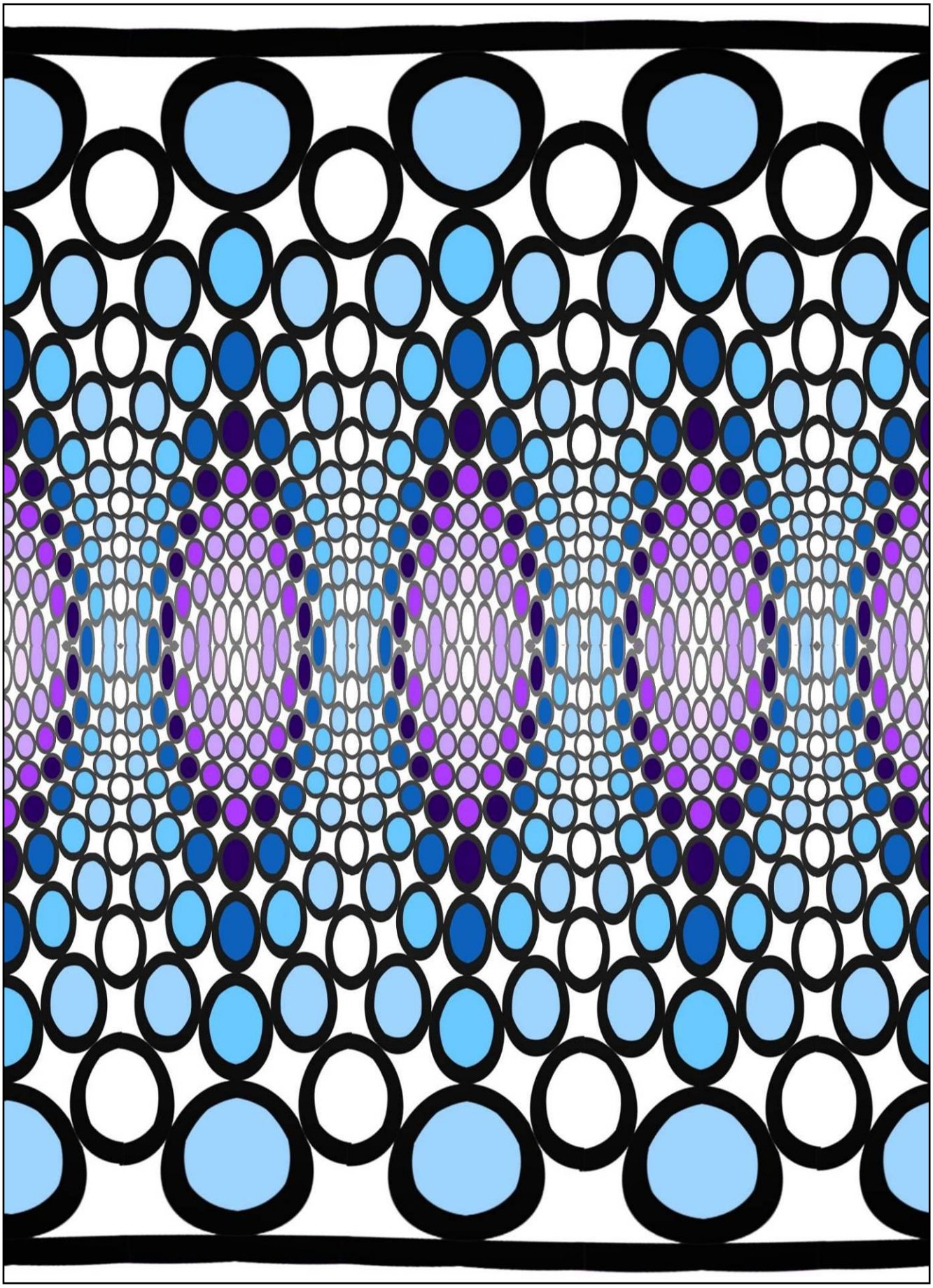
Manipulations sur la transformation polaire :
Suppression d'un élément, polarisation inverse et changement de couleur.
Symétrie verticale et polarisation inverse.
Rajout de deux éléments, polarisation inverse et changement couleur.

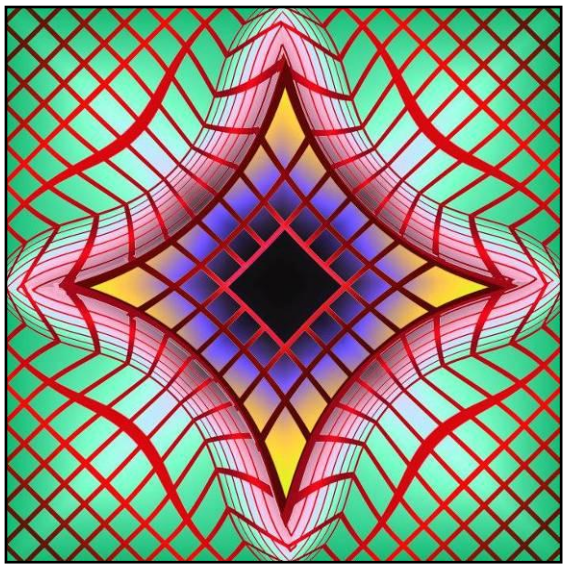


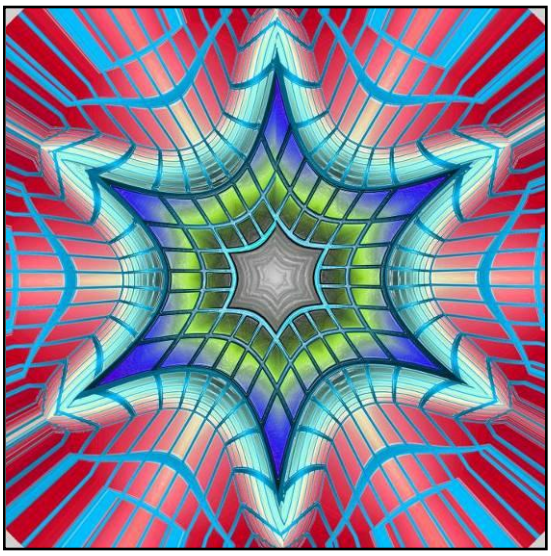


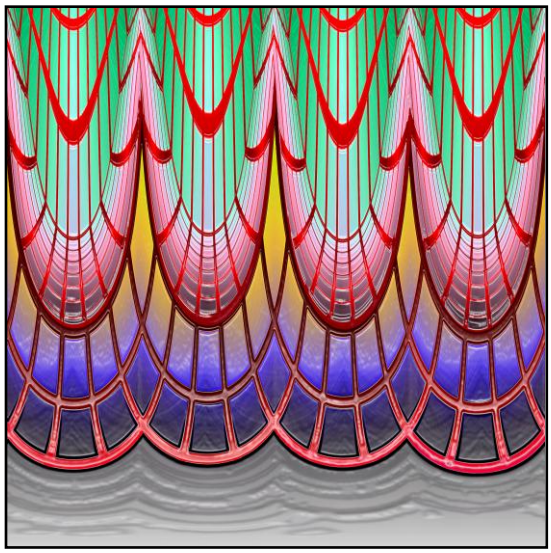


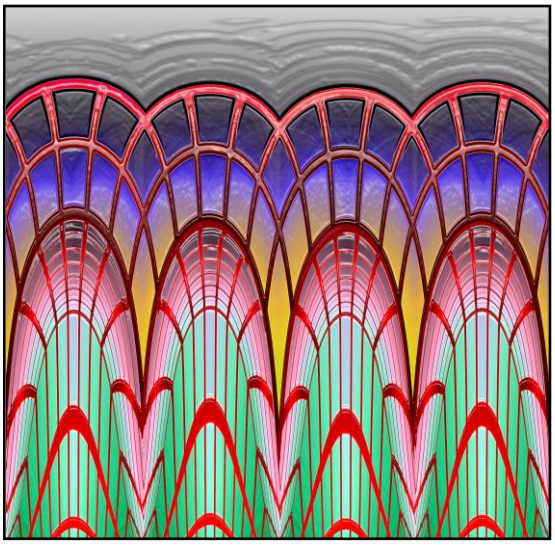


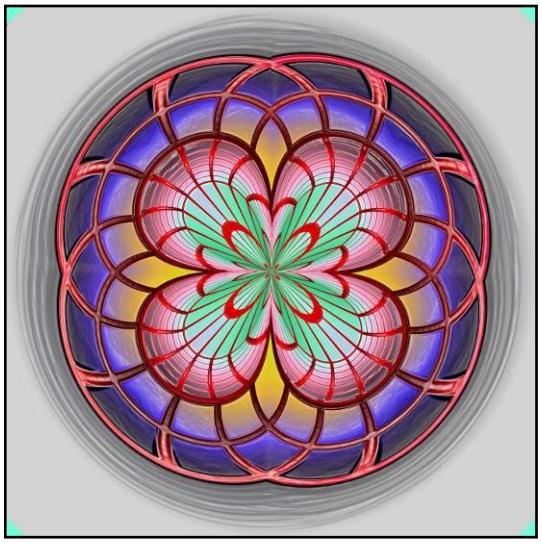


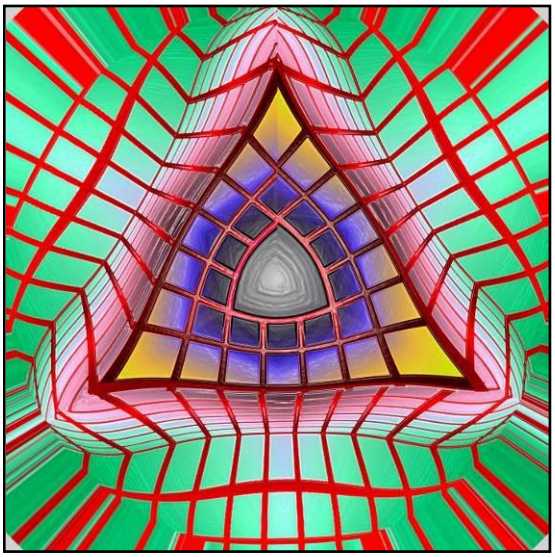


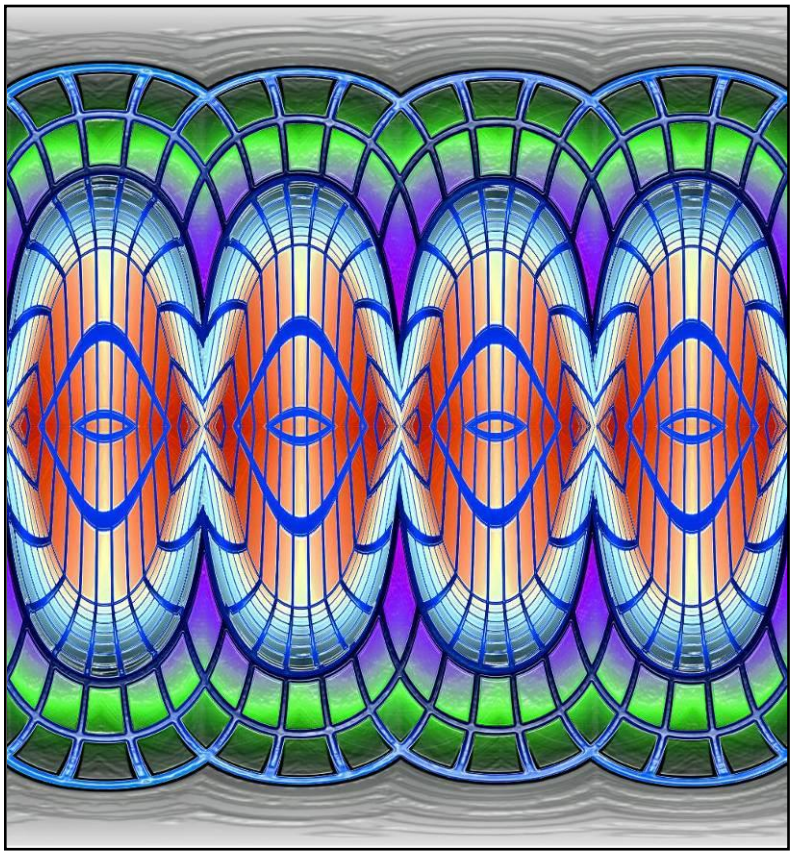


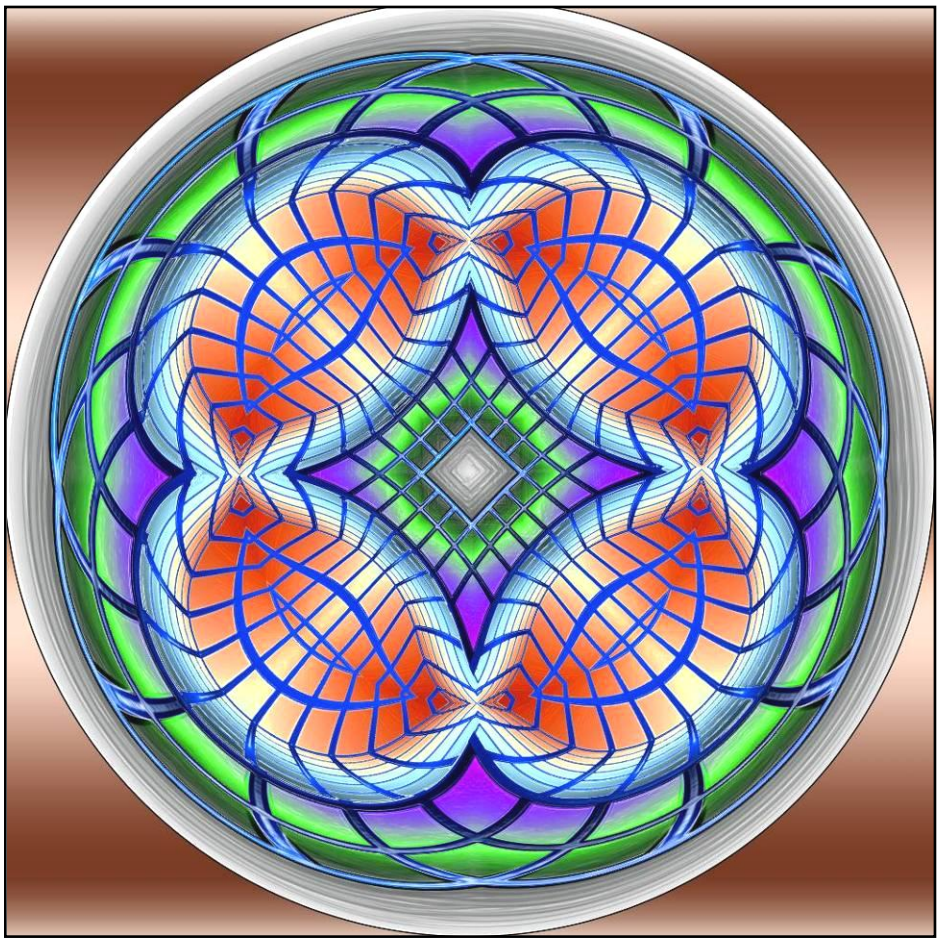




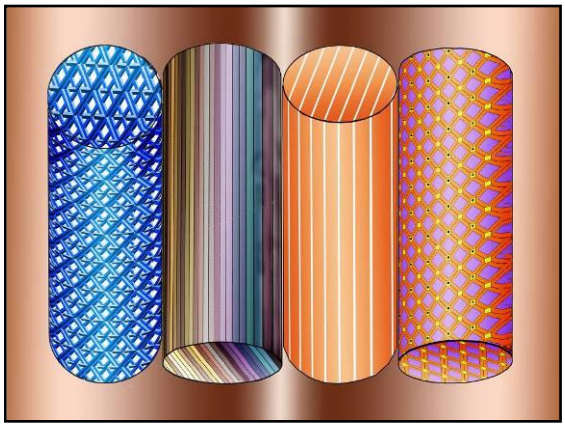


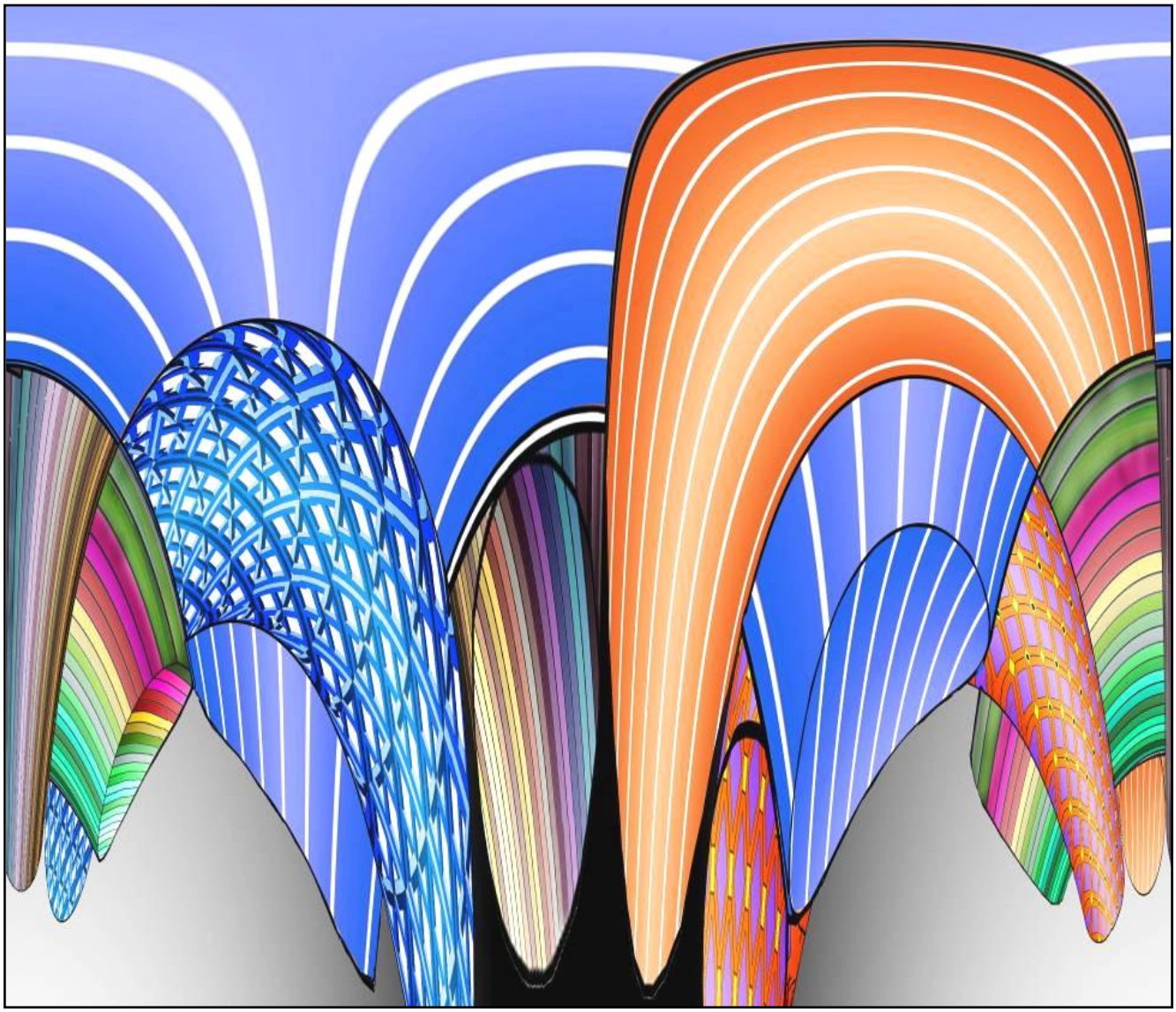


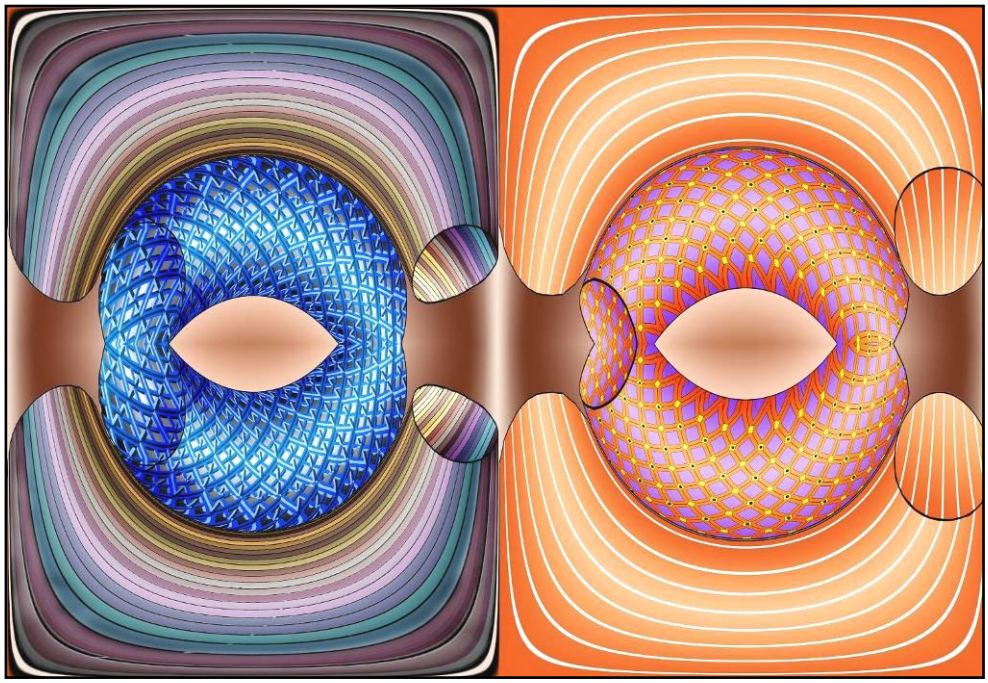


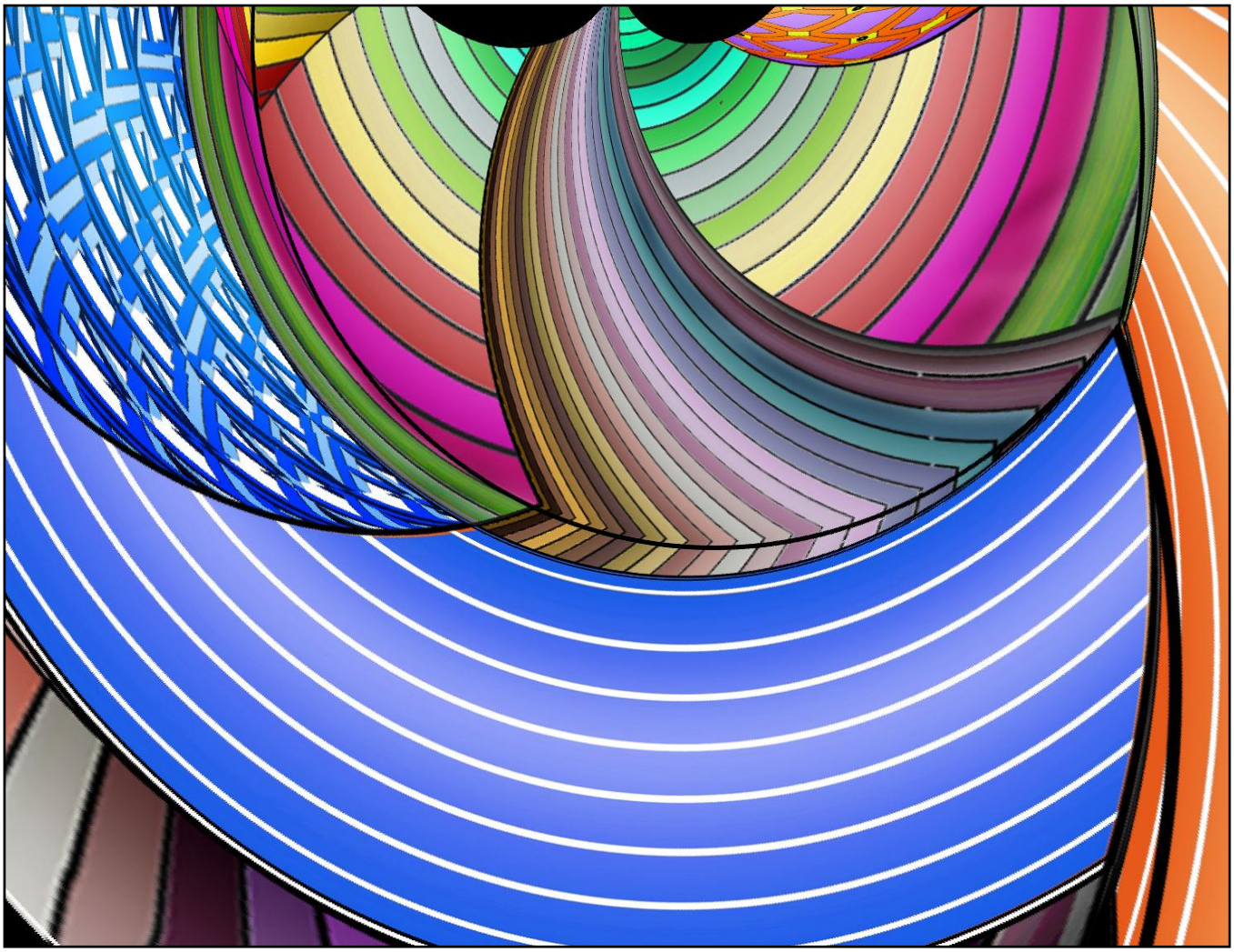


PHOTOGRAPHIES









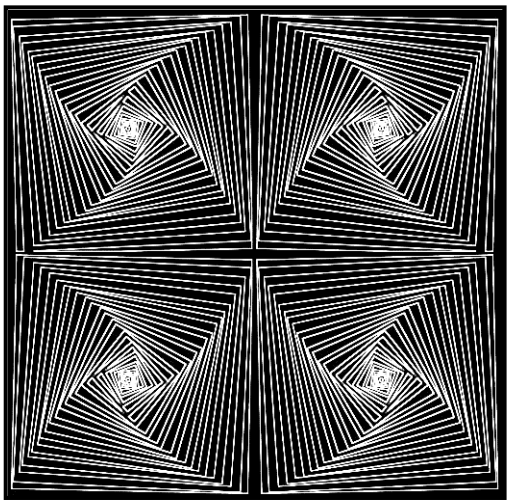
Constructions diverses :

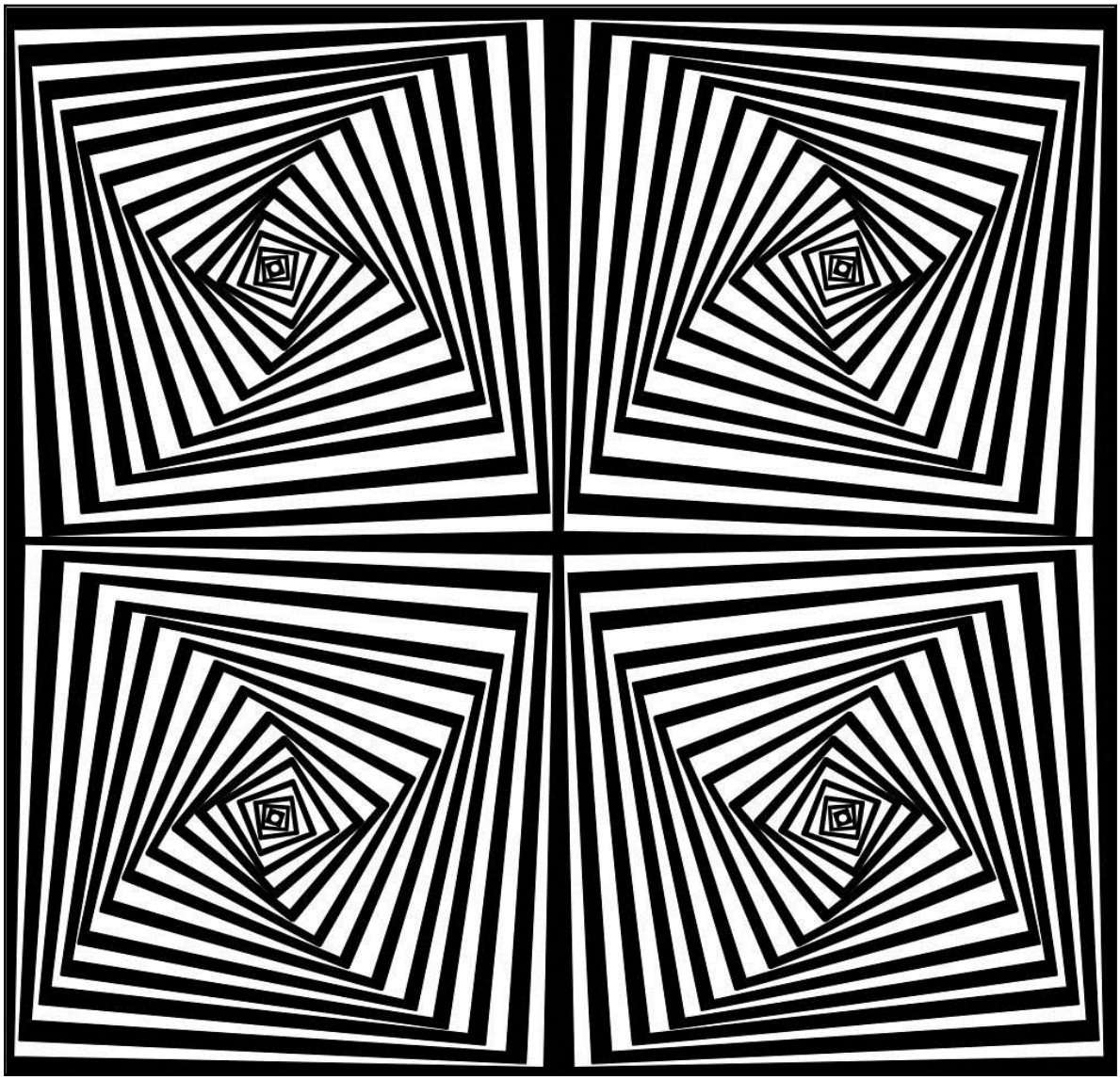
CONSTRUCTION

Au départ, le grand carré déformé et sélectionné subit, par étages, la même diminution et la même rotation vers la gauche jusqu'au minuscule carré central. La couleur en dégradé est obtenue en sélectionnant chacune des parties.

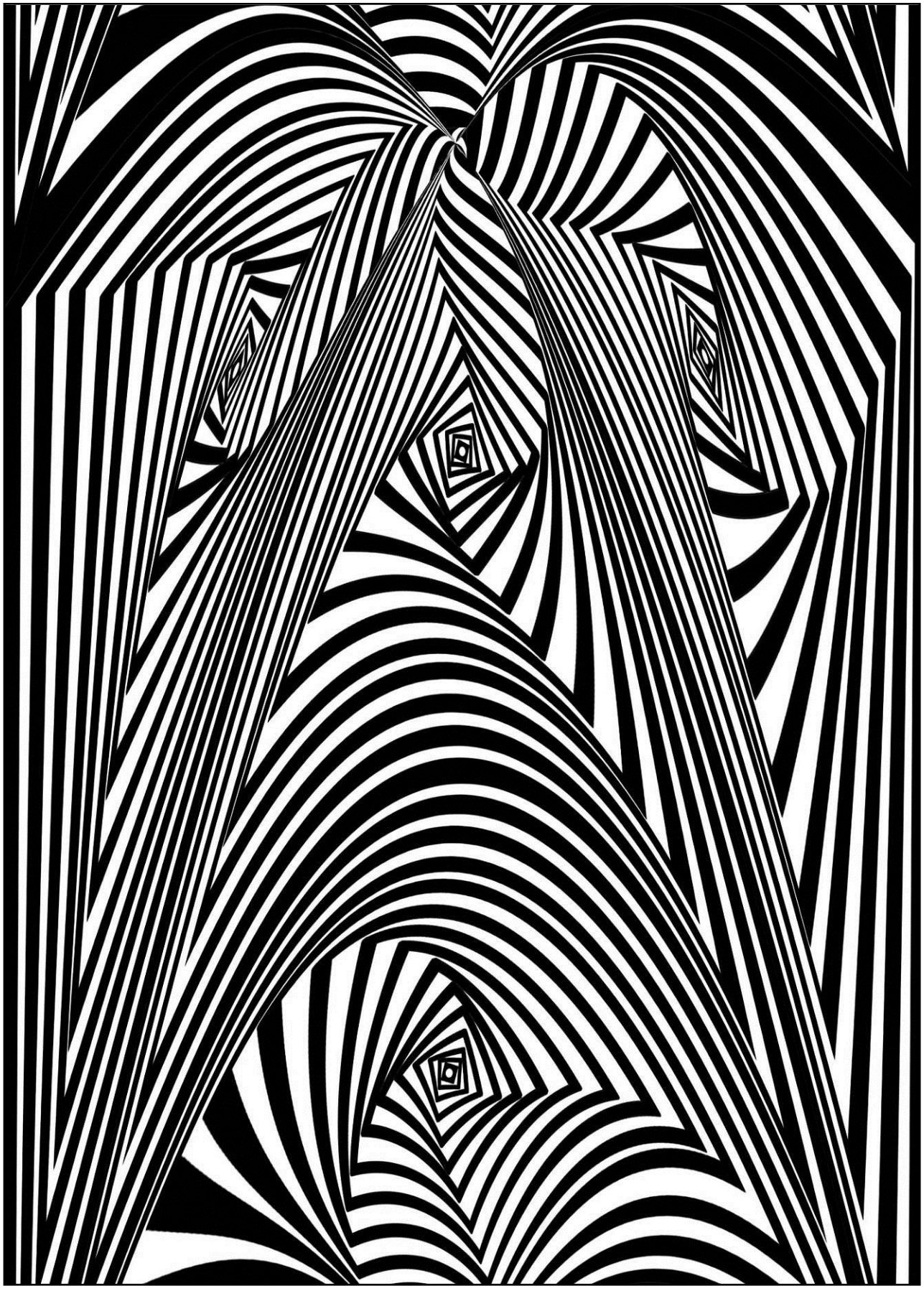
RETOUR

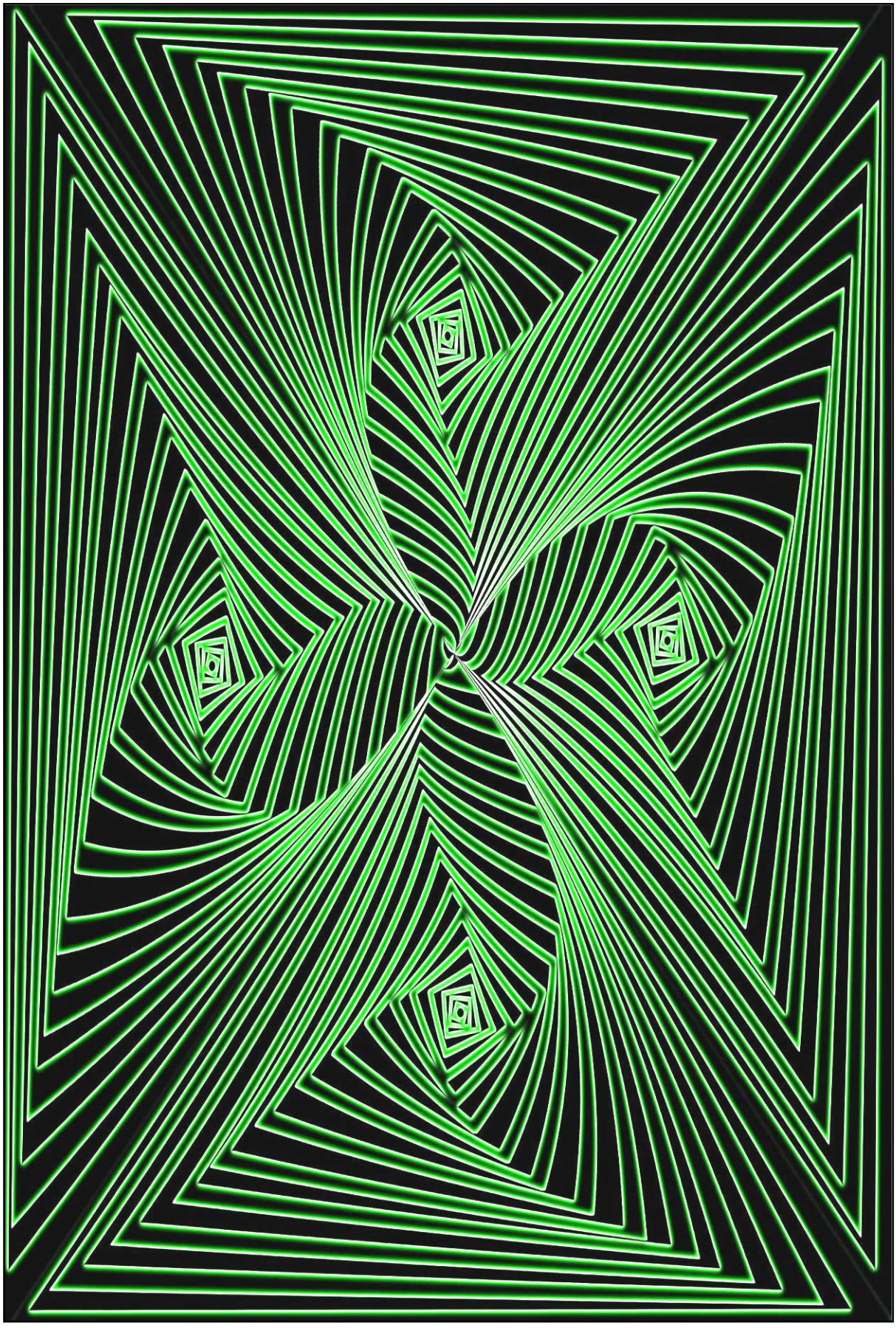
CONSTRUCTION



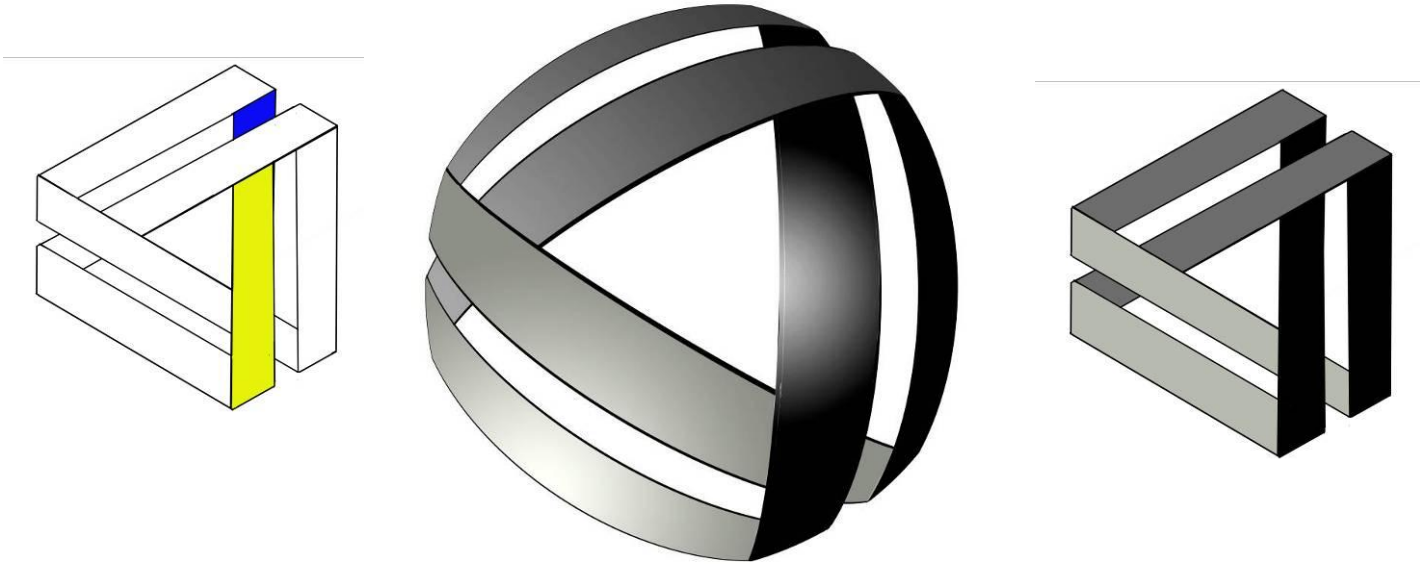


Copie de quatre éléments de base subissant chacun une rotation de 90°. Filtre CONTOUR LUMINEUX ;





PHOTOGRAPHIES	DIAPORAMA	CONSTRUCTION



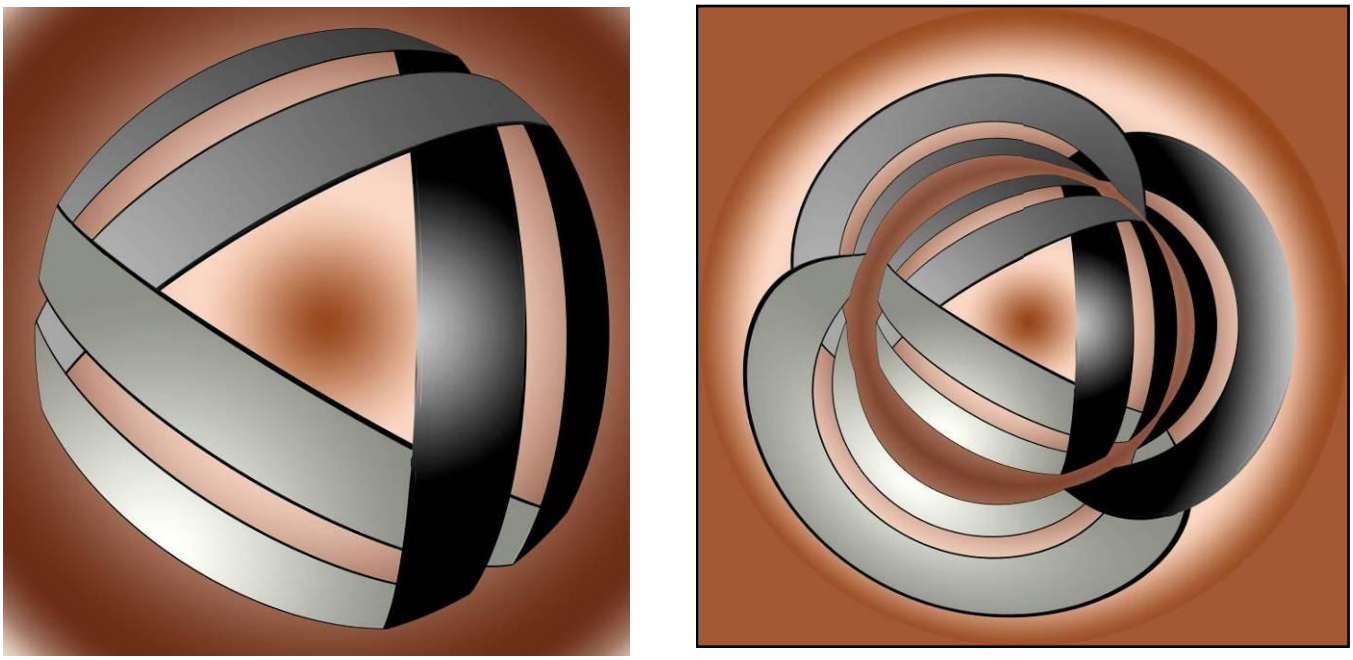
La composition des deux parallélogrammes (en jaune et en bleu) permet de construire le double anneau de Moebius.

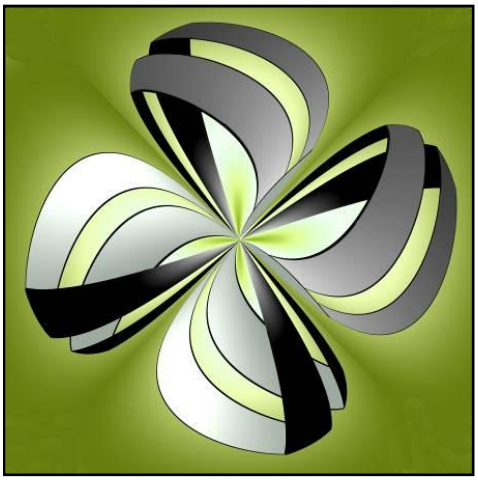
Les segments de cet anneau sont ensuite dégradés.

L'ensemble est alors sphérisé.

Un dégradé coloré est ensuite posé sur une sélection de fond.

Pour la figure de droite : polaire en rectangle, symétrie d'axe vertical, rectangle en polaire.



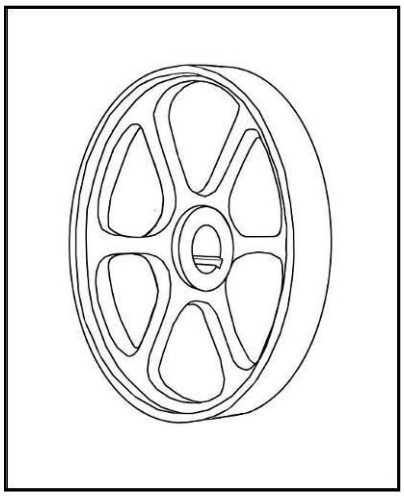


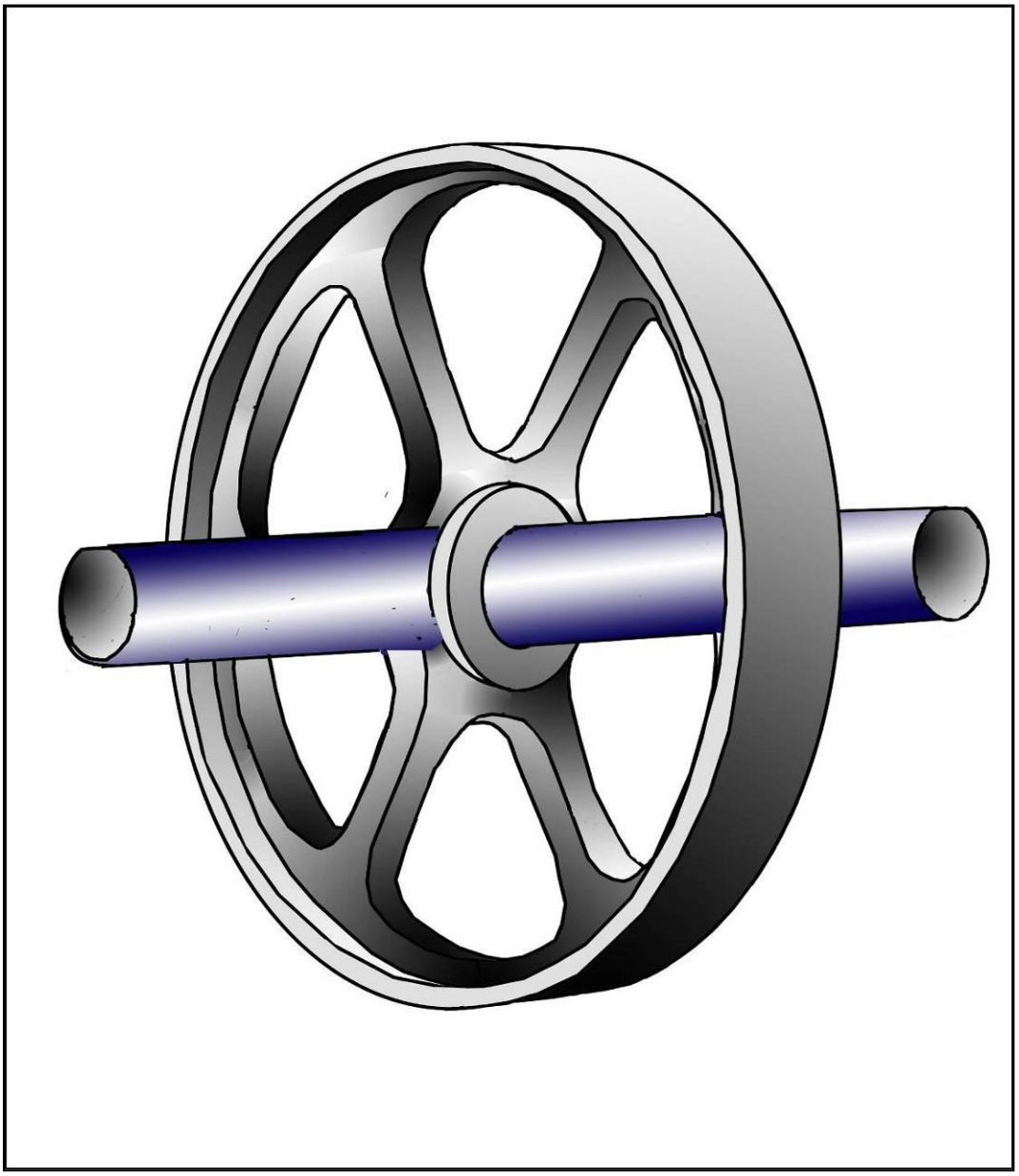
Au dessus : composition de trois anneaux précédent ; les entrelacements sont construits manuellement.

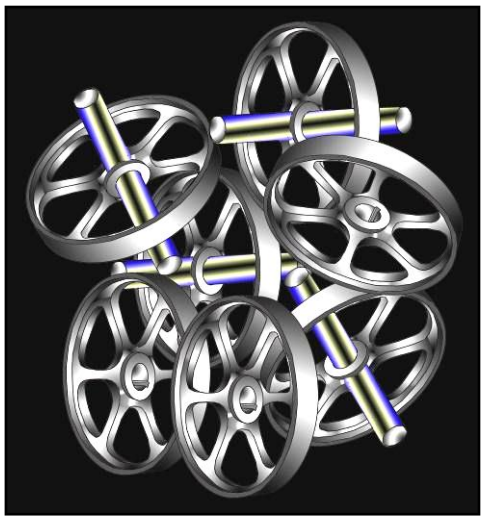
Travail avec l'option perspective, copier, coller, rotation et aplatissement de l'image.

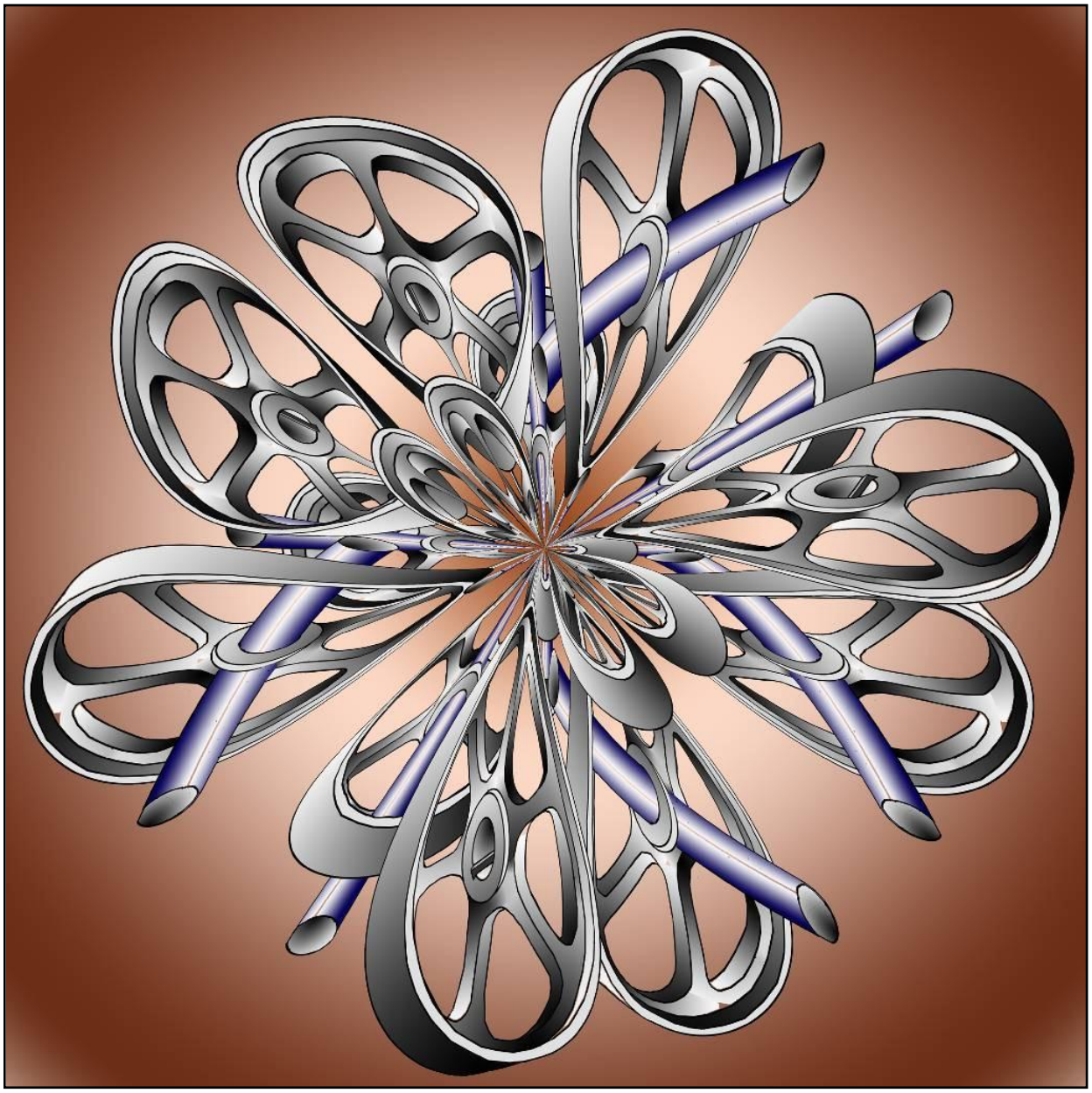
PHOTOGRAPHIES

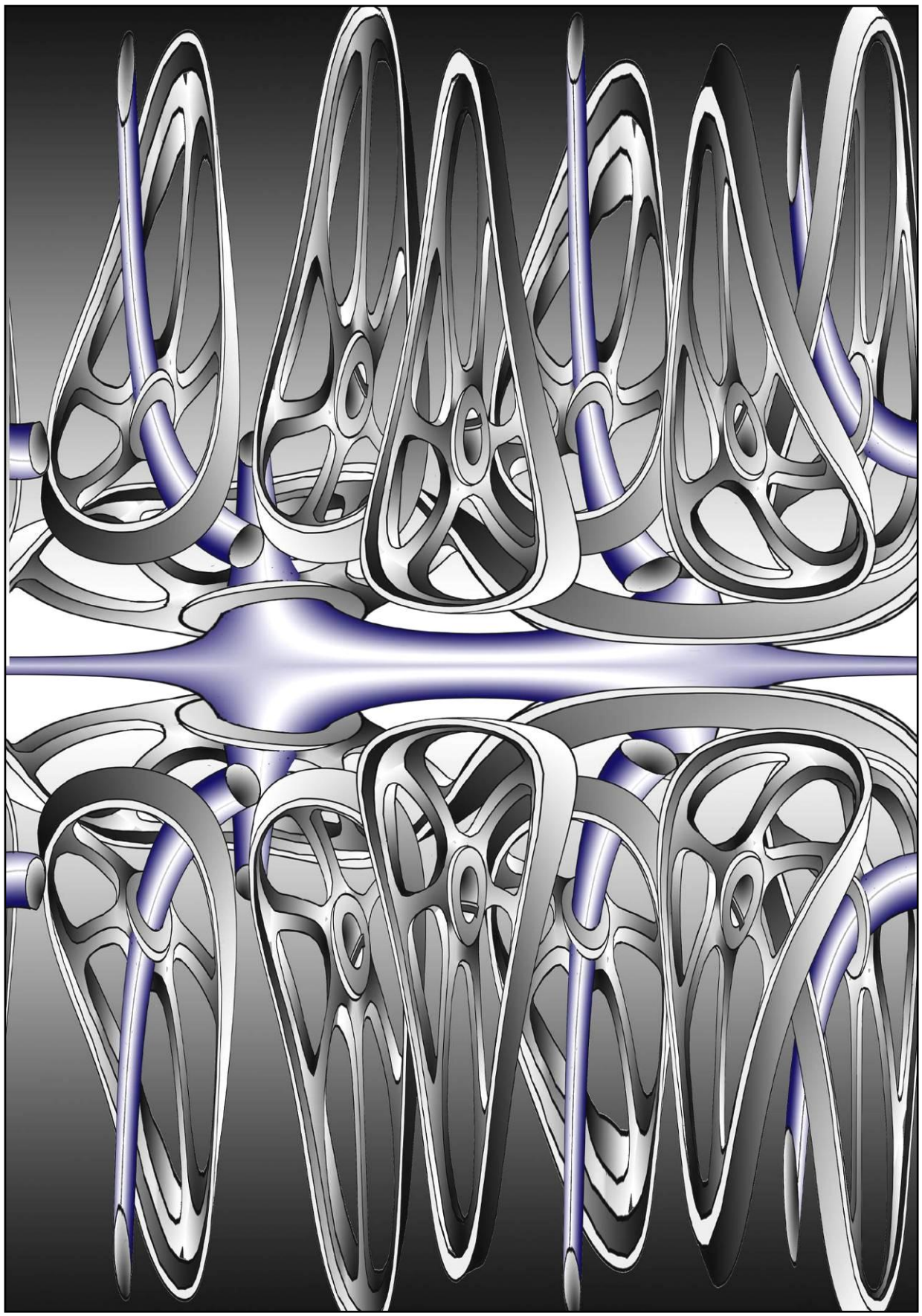
DIAPORAMA





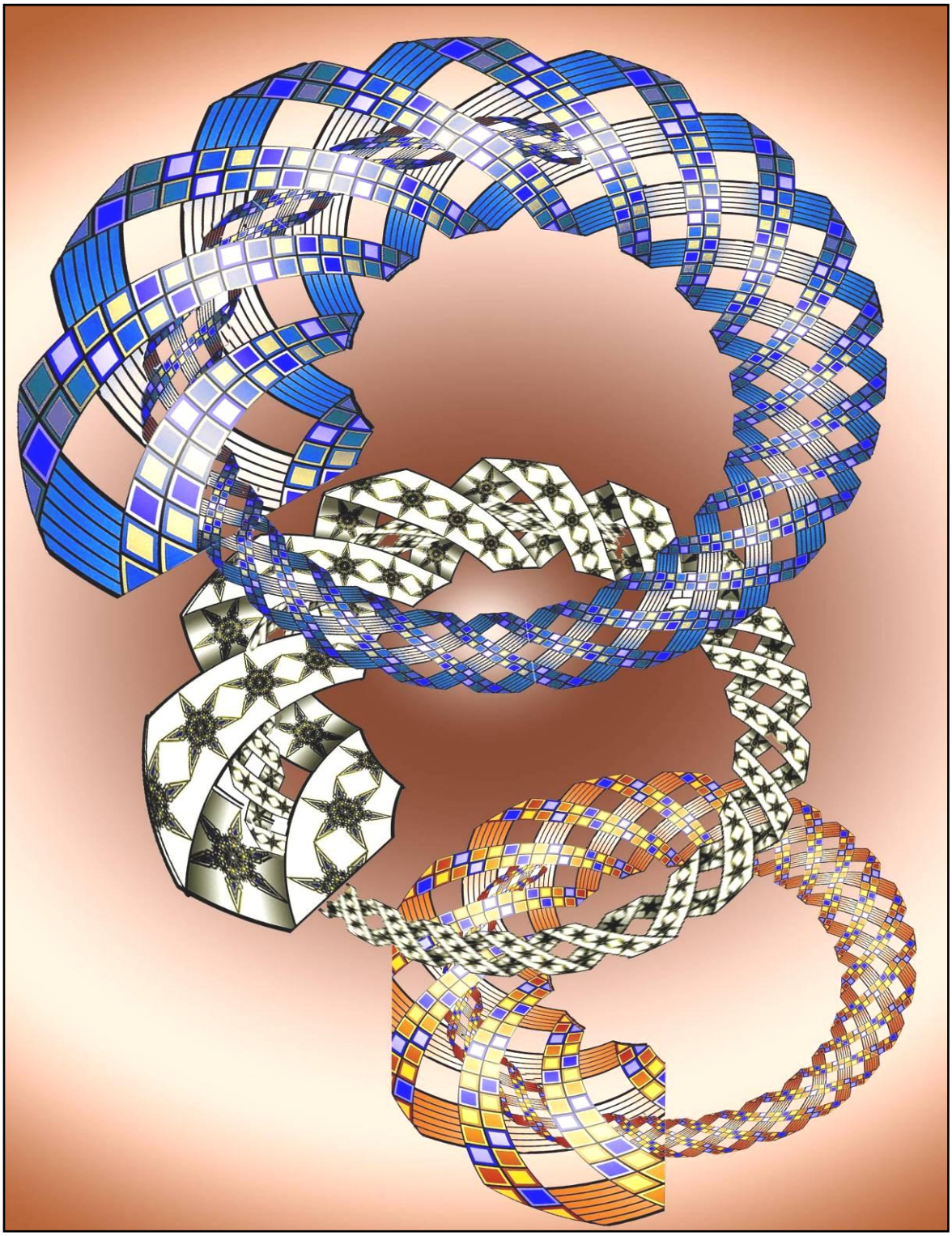




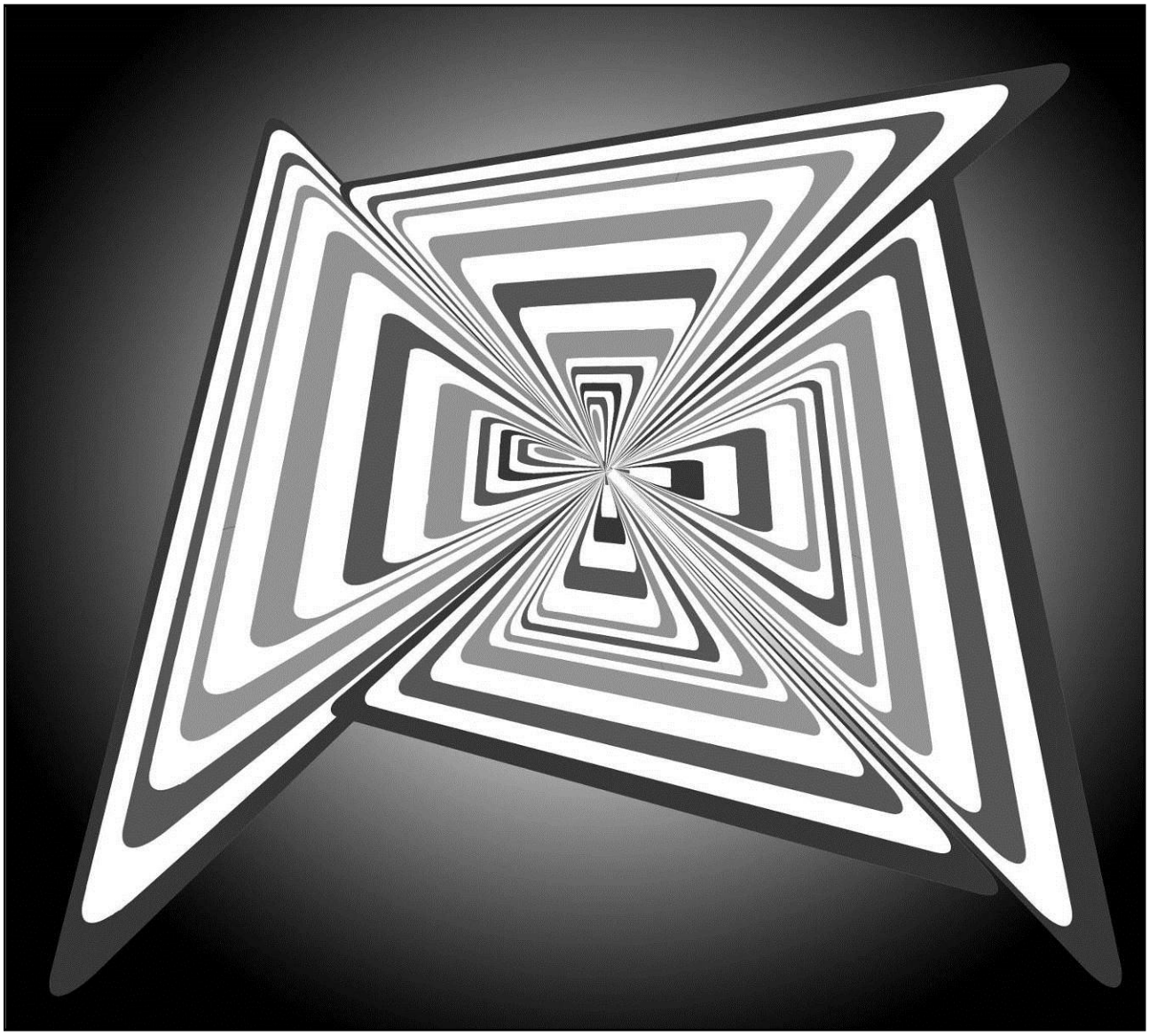


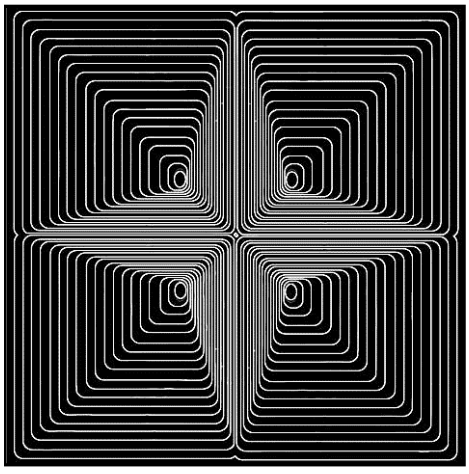
CONSTRUCTION

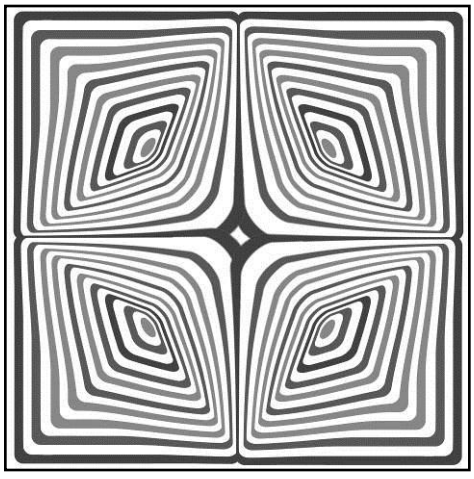
Arabesques modernes.

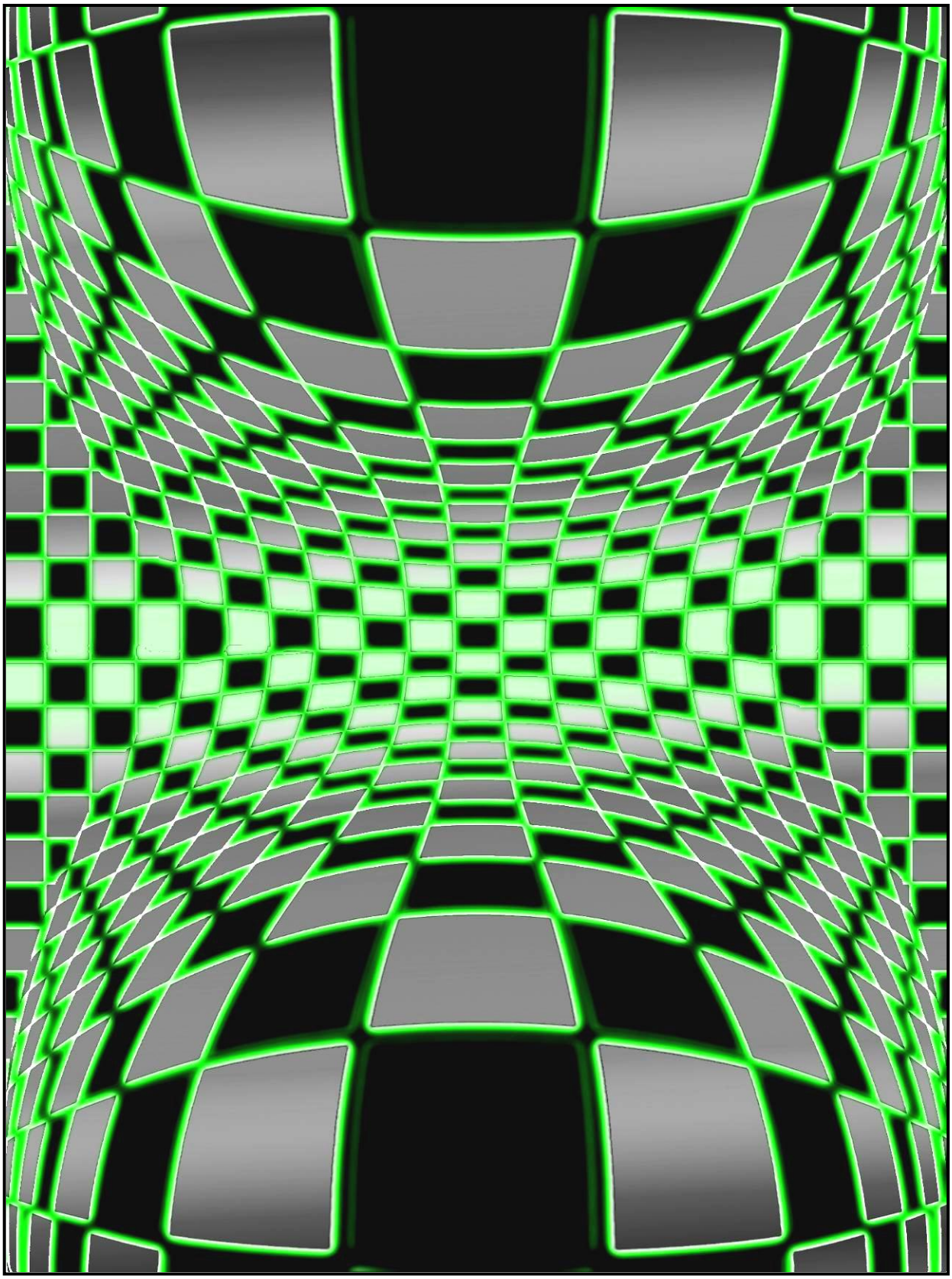


RETOUR









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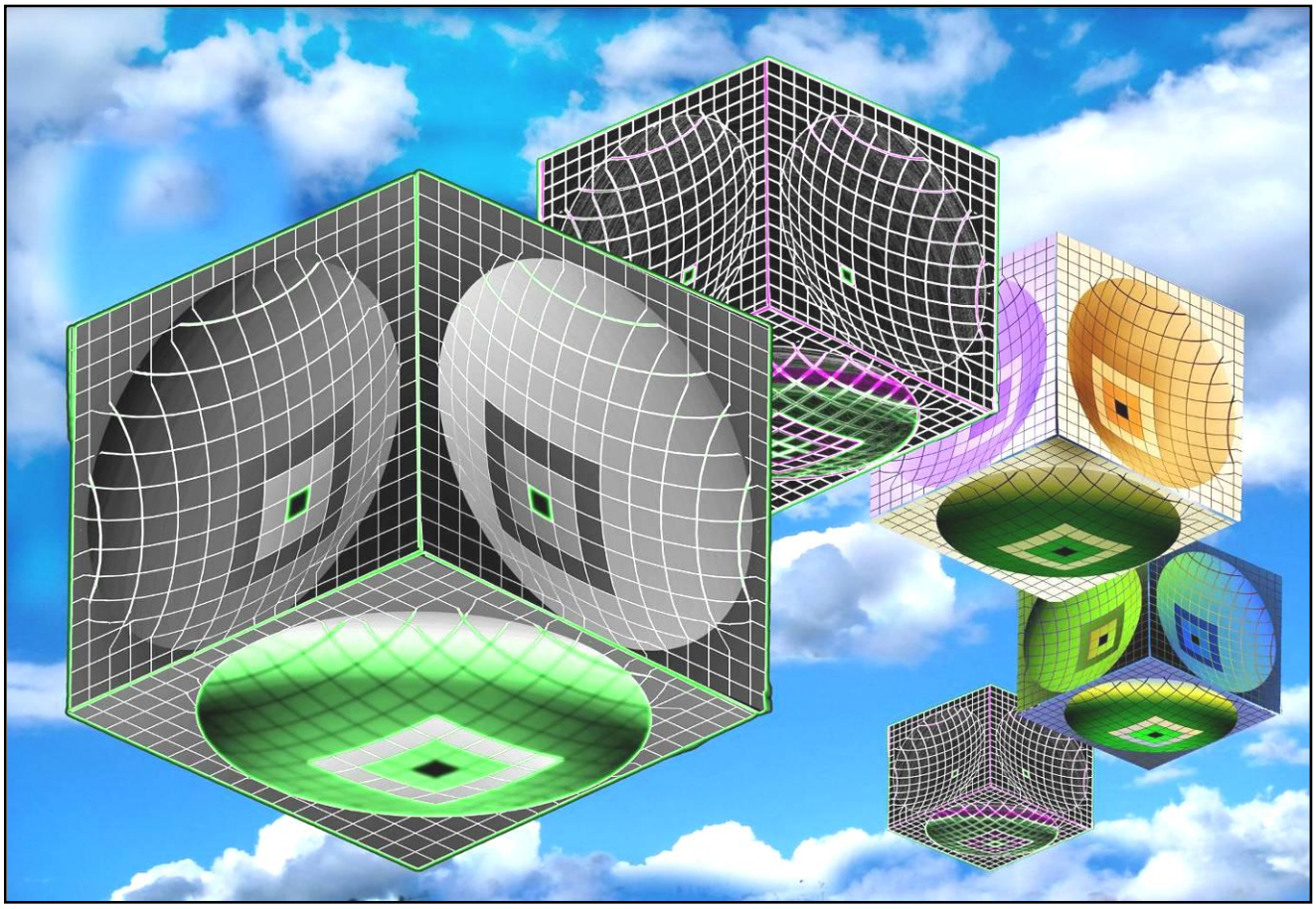

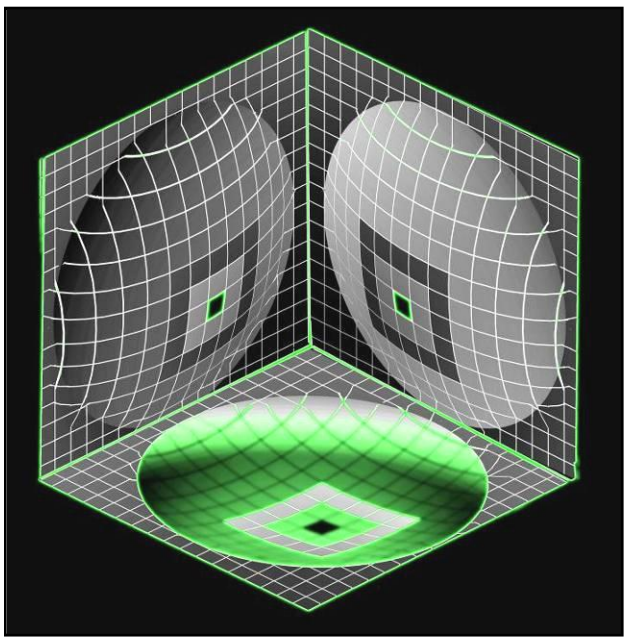

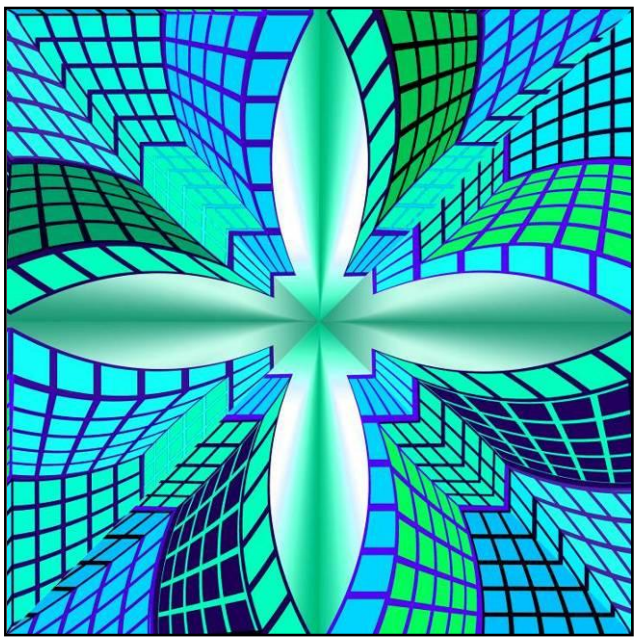

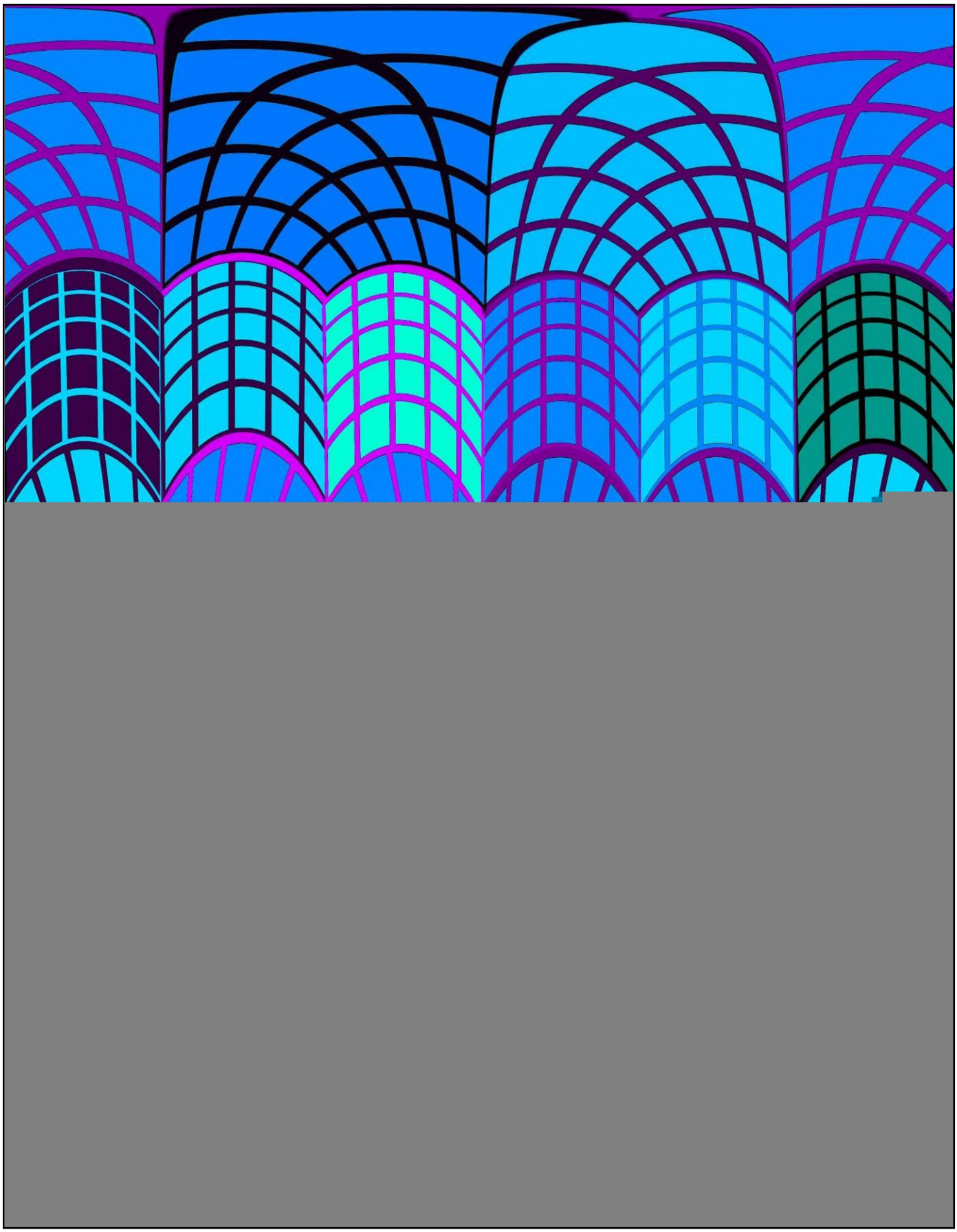

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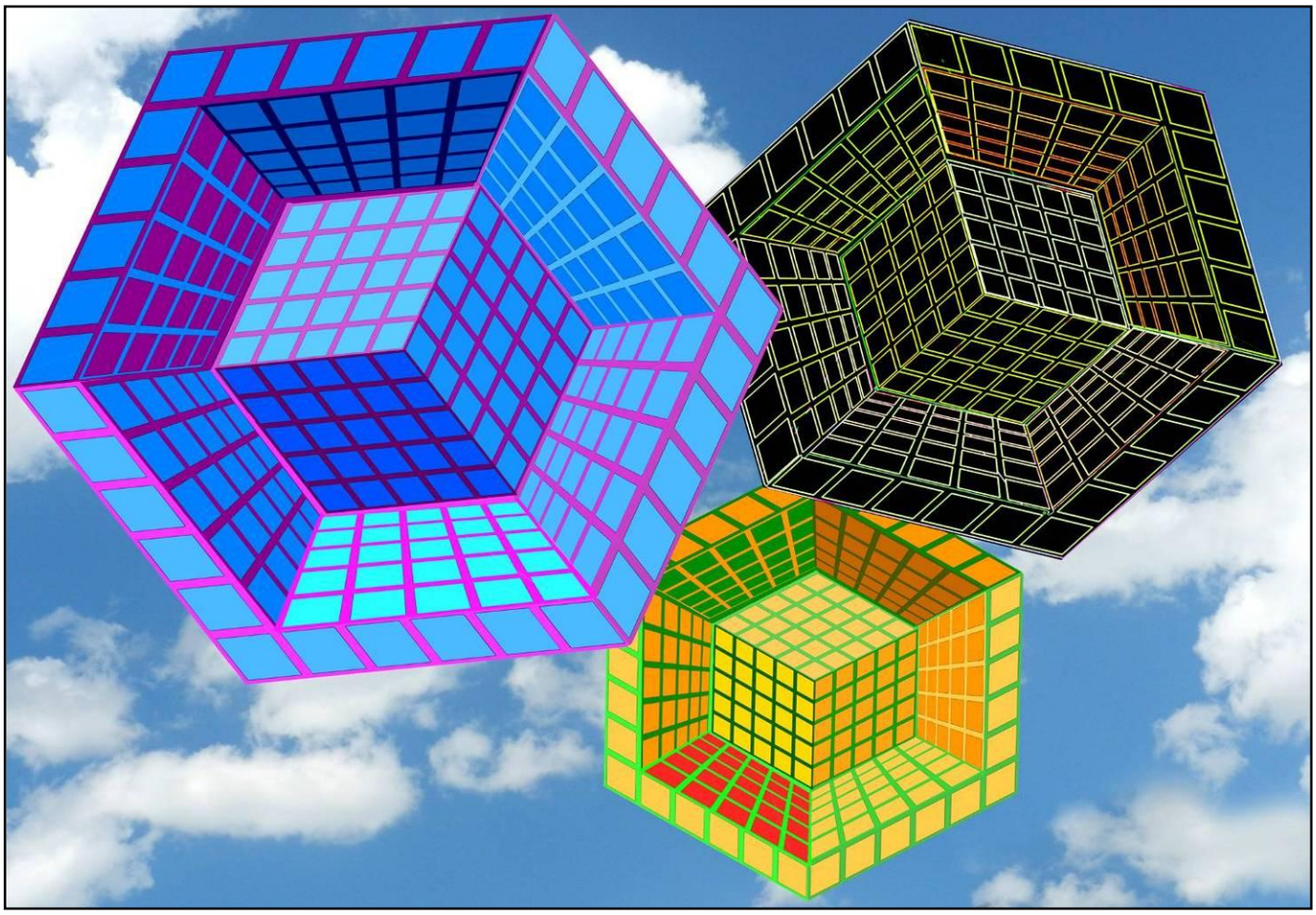

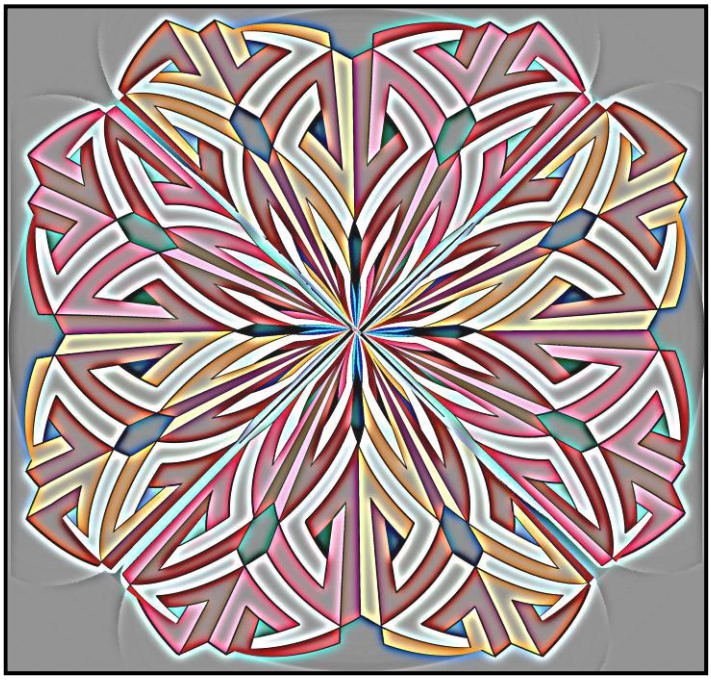

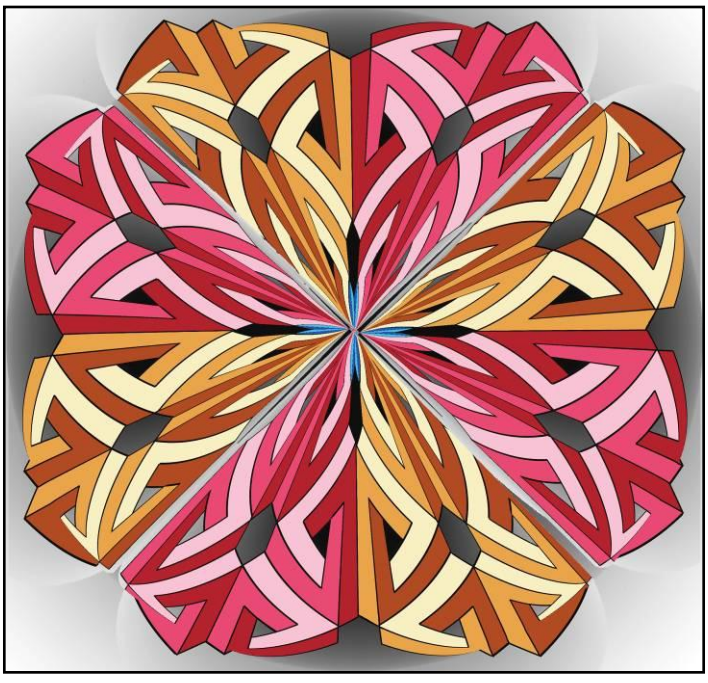

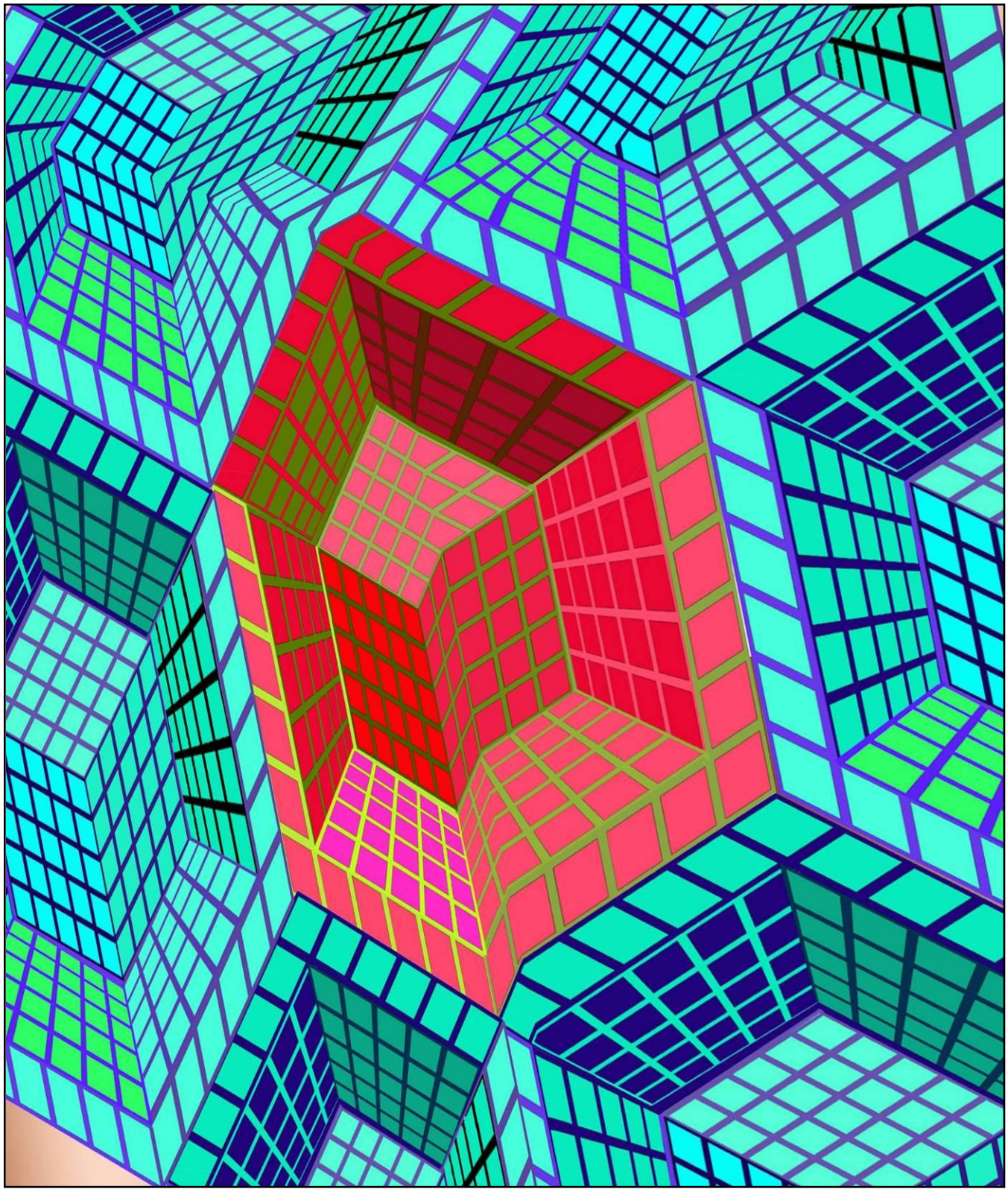

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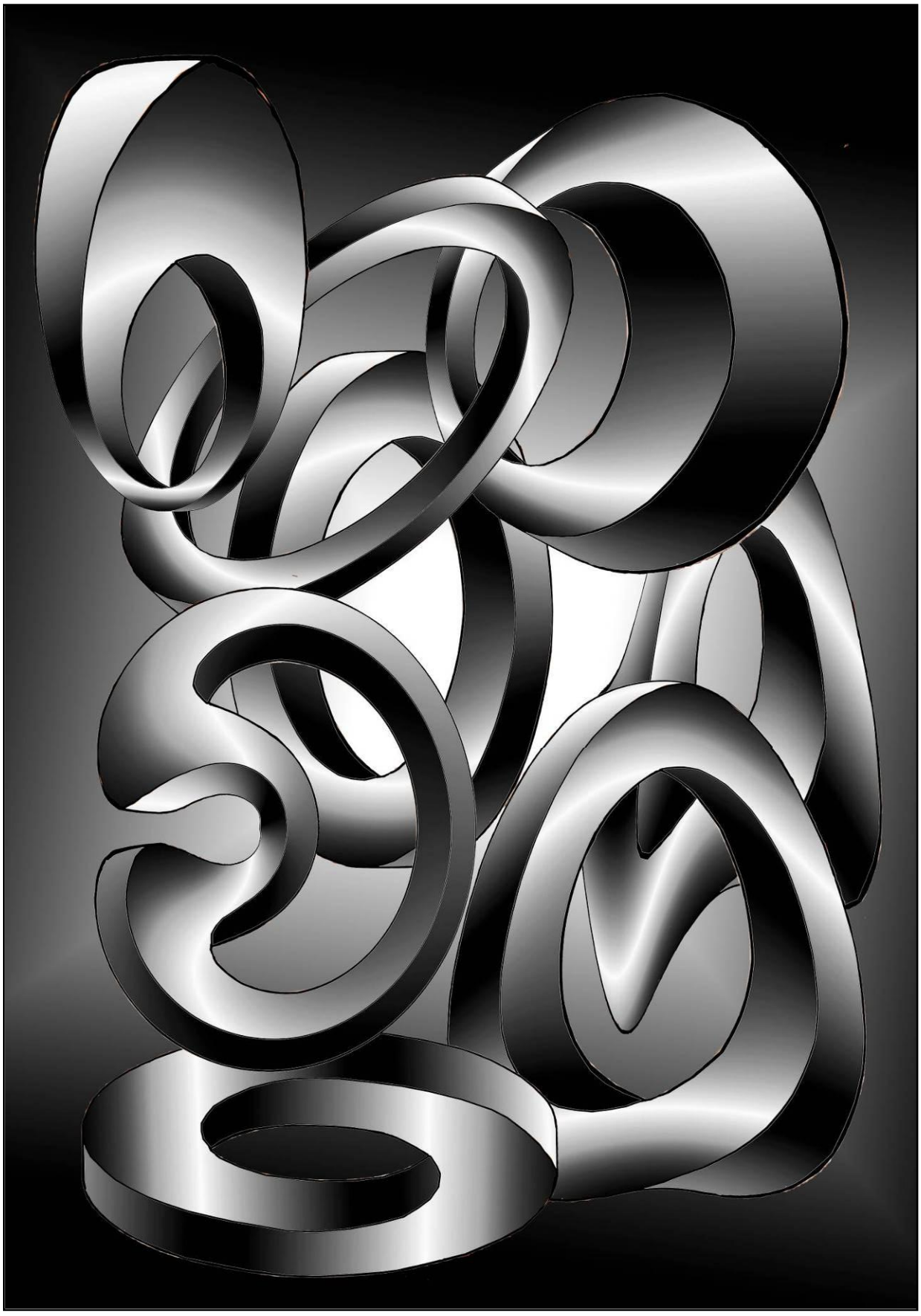

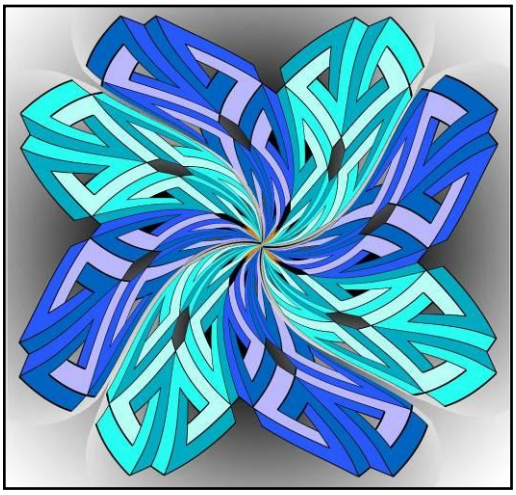

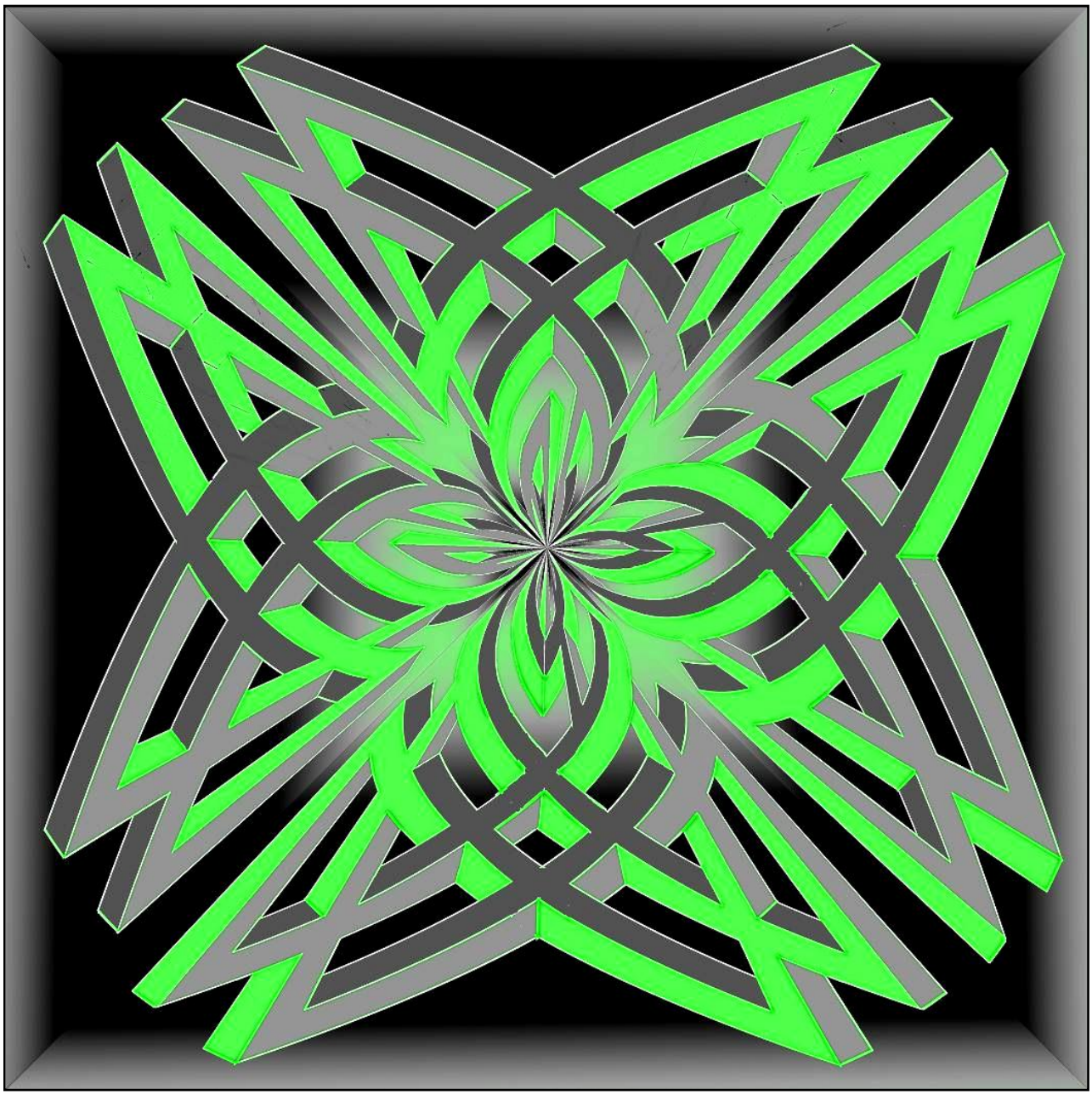

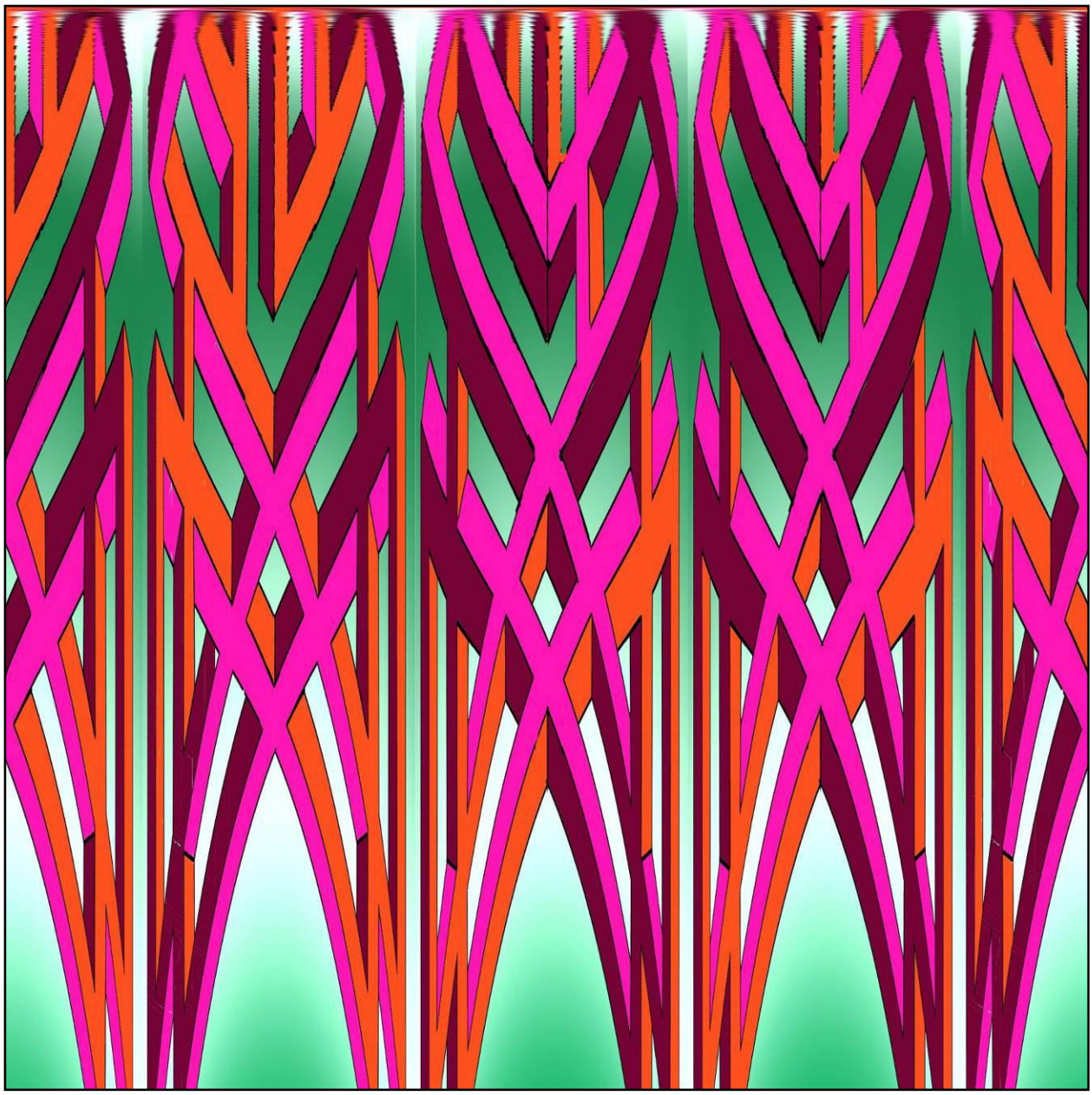

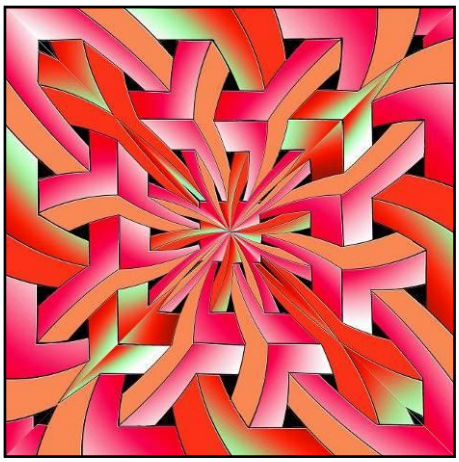

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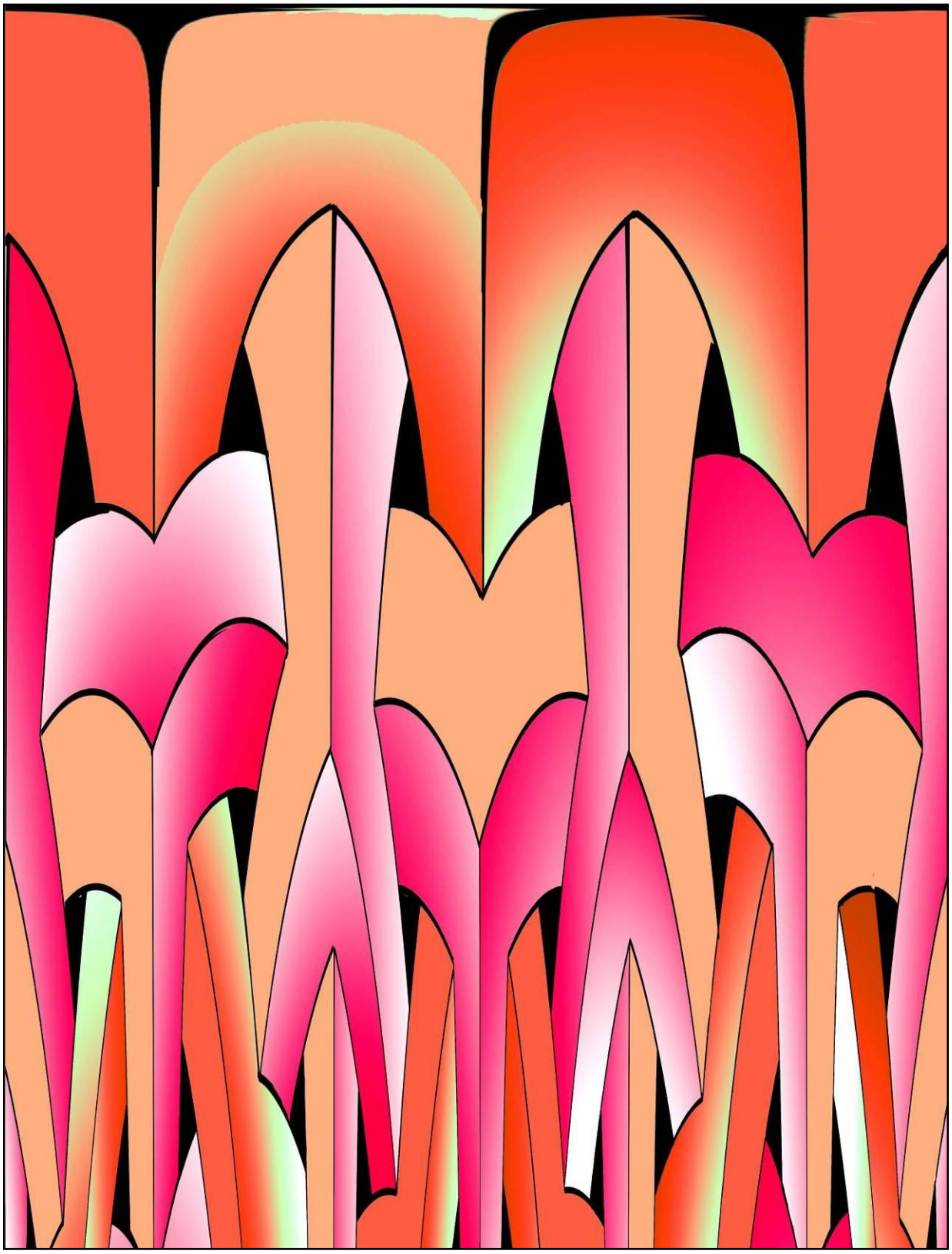

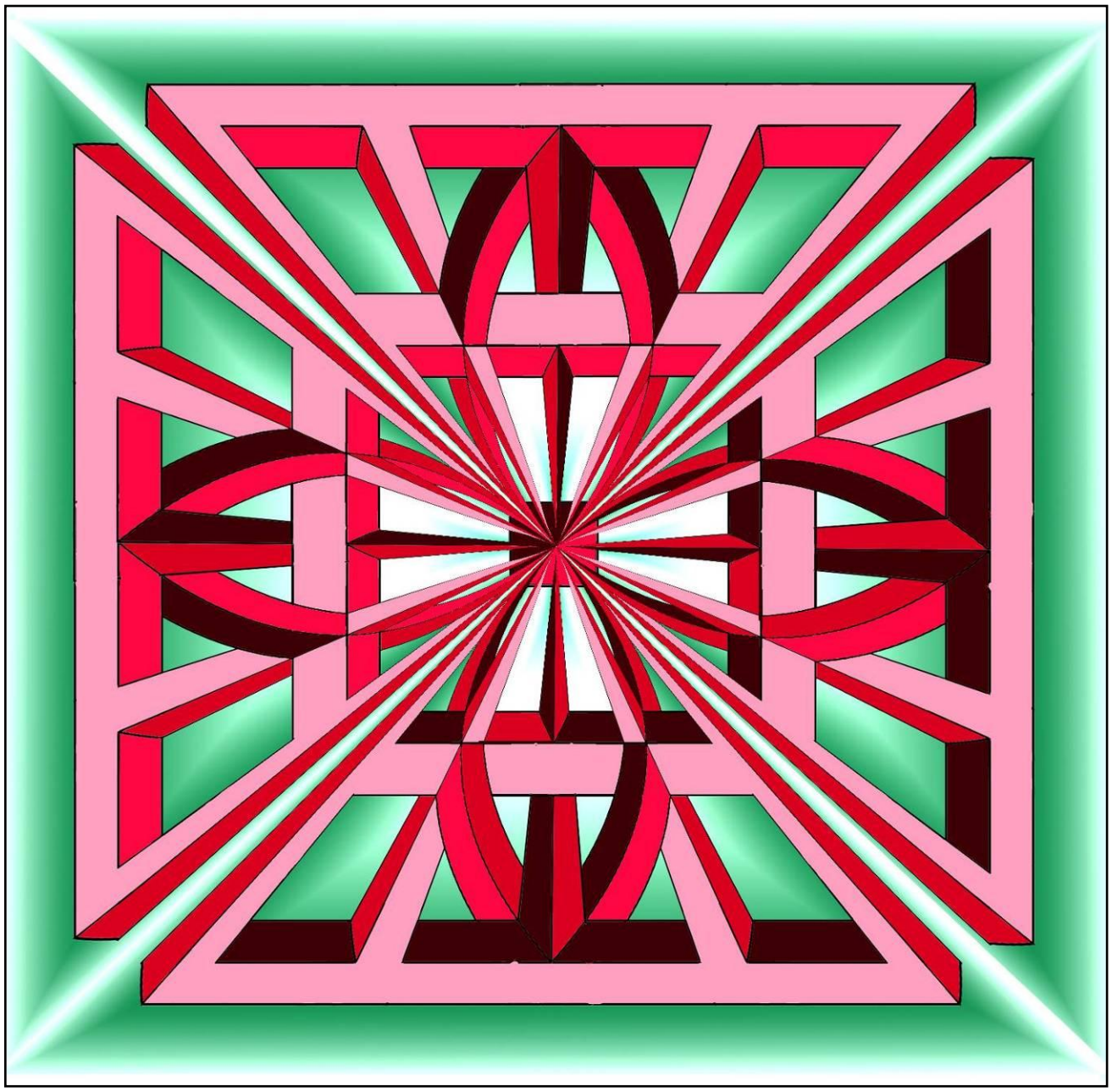

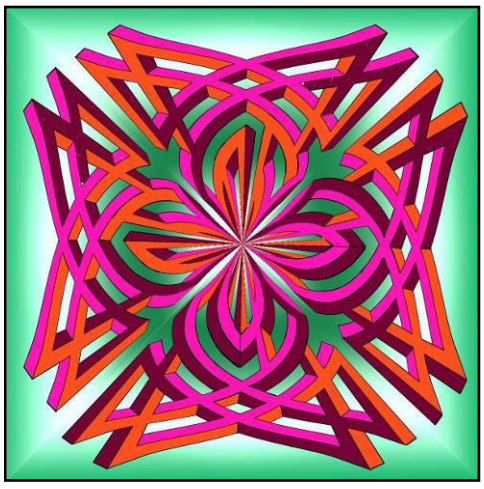

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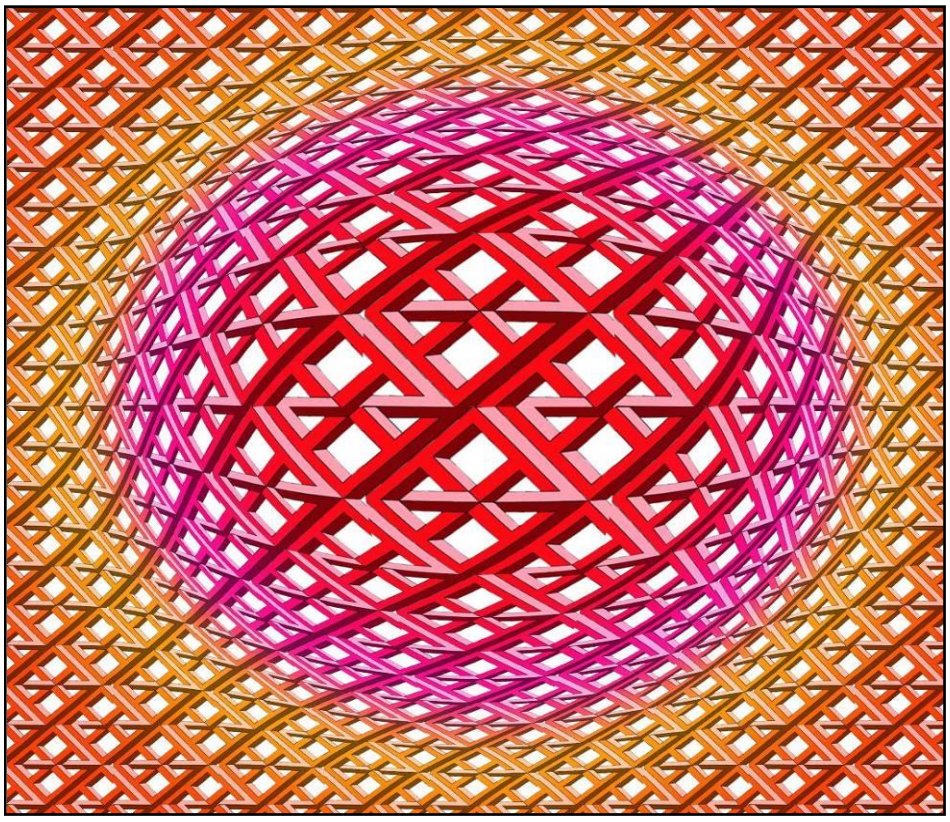

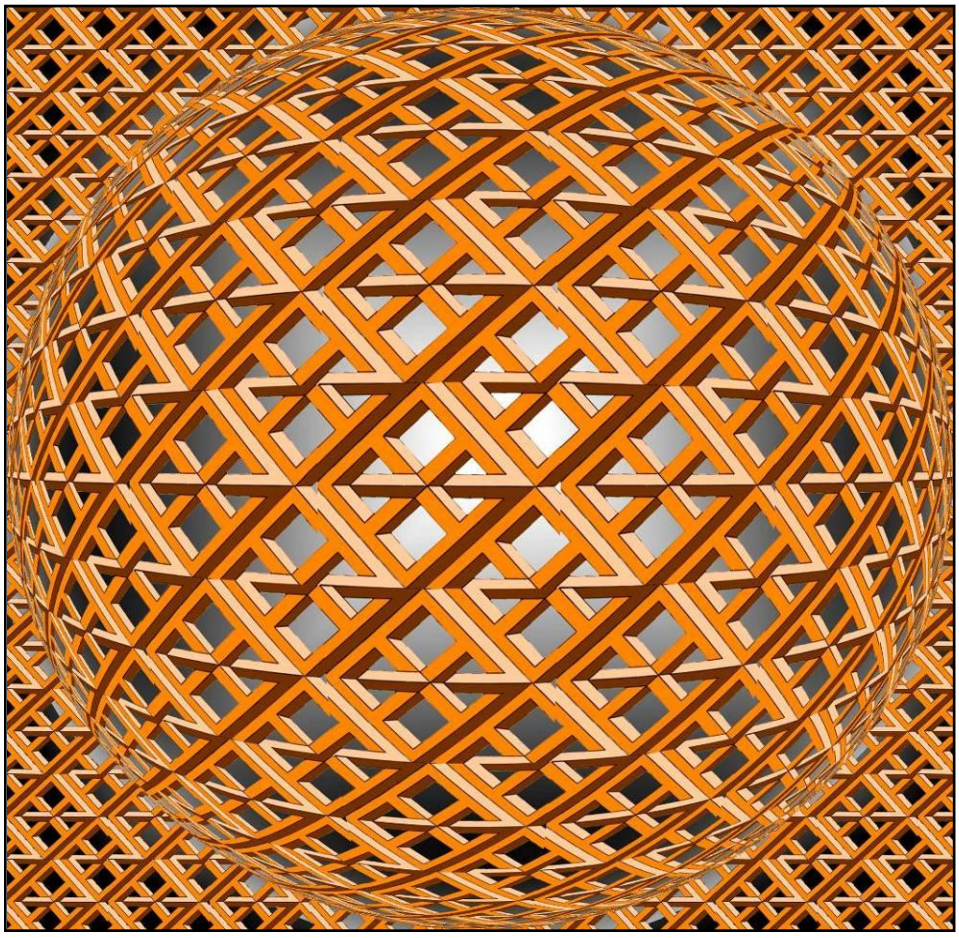

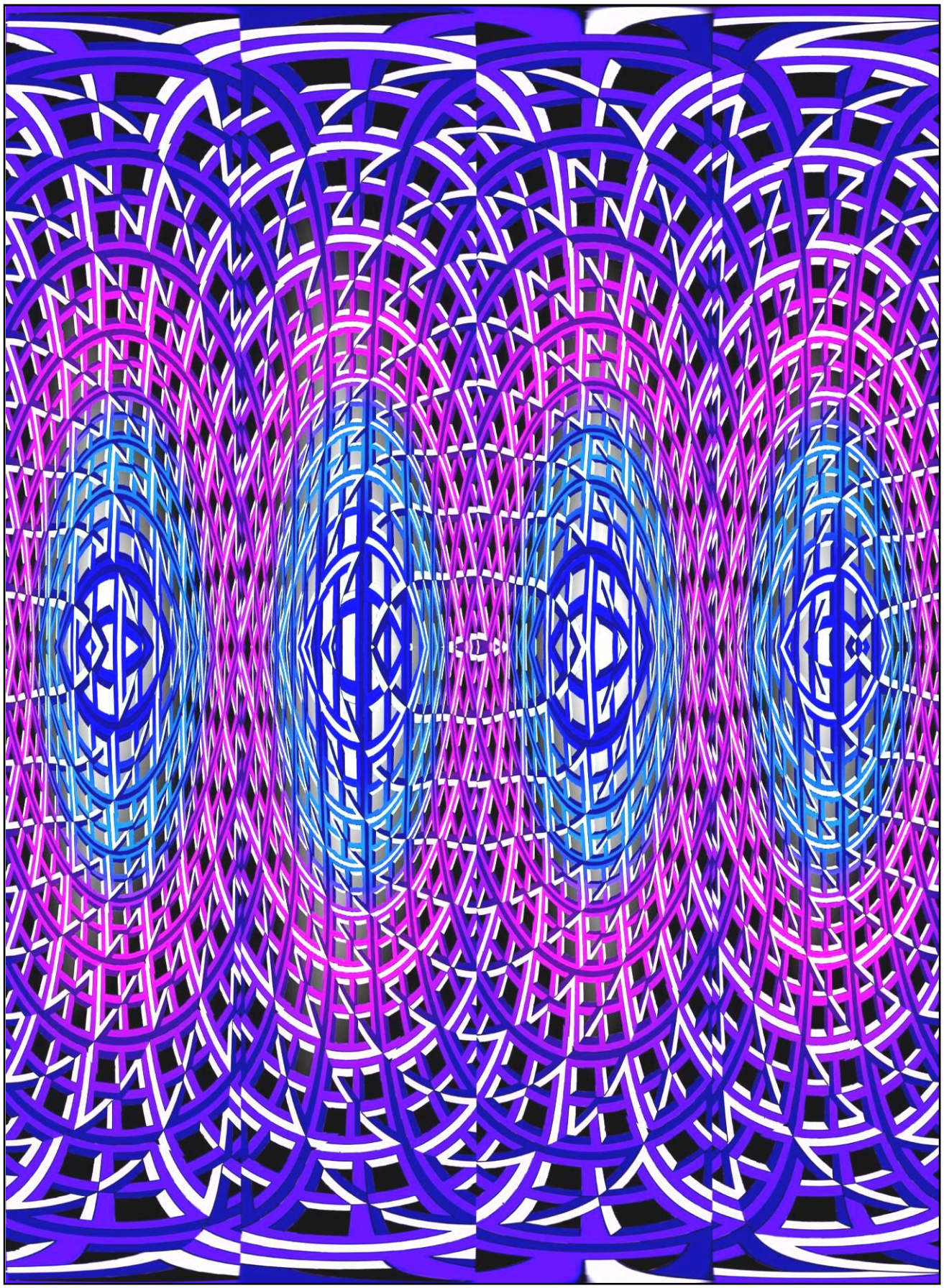

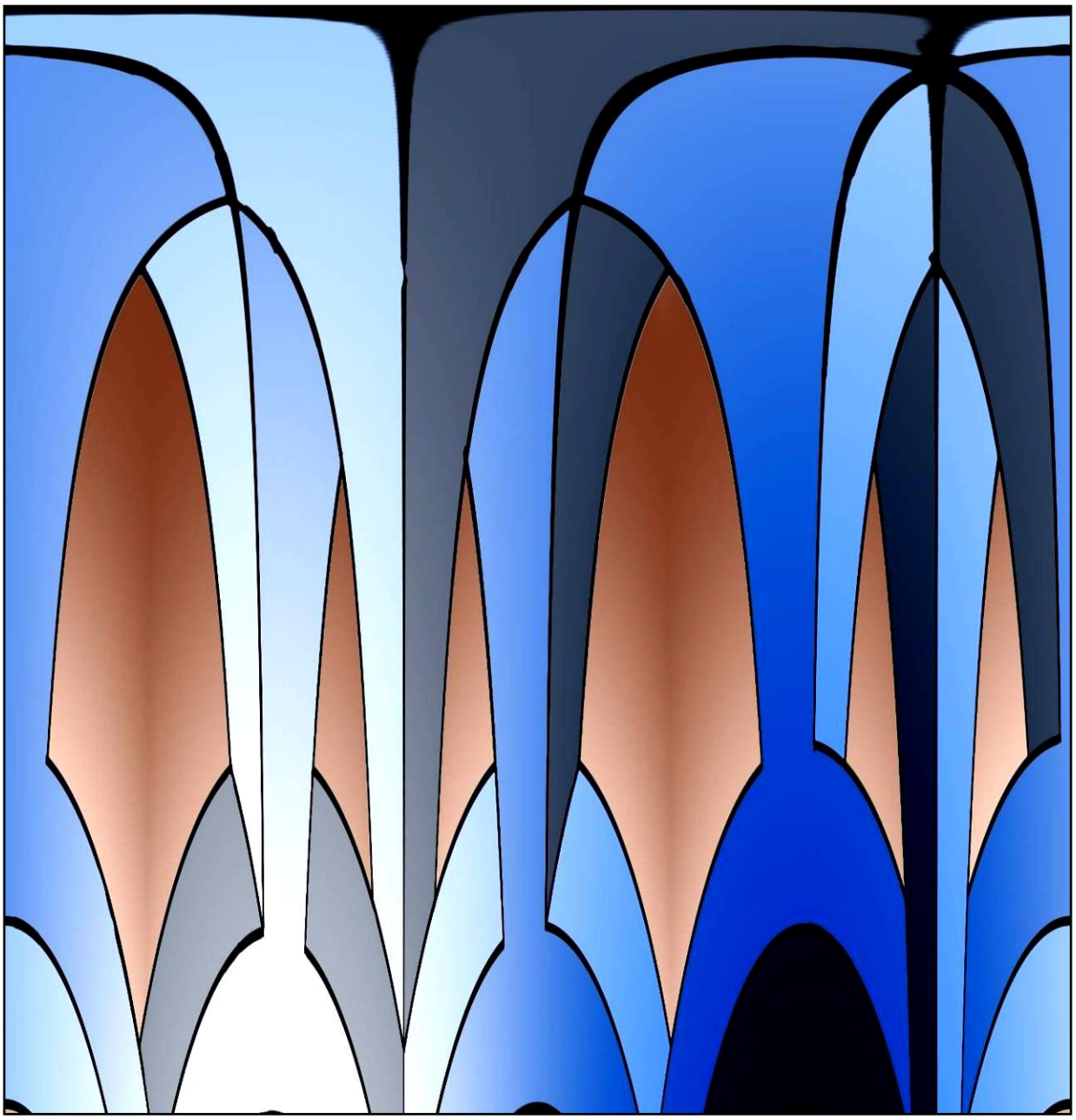

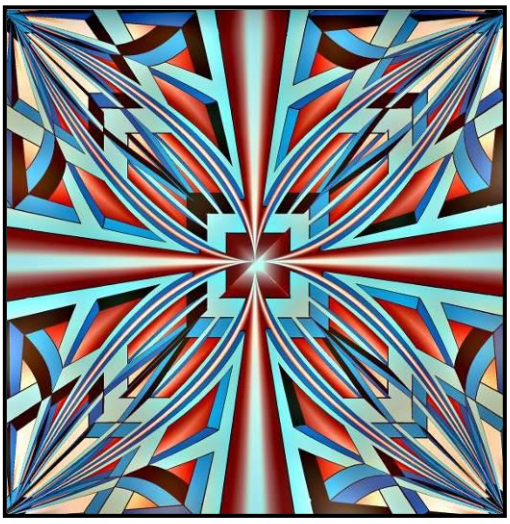

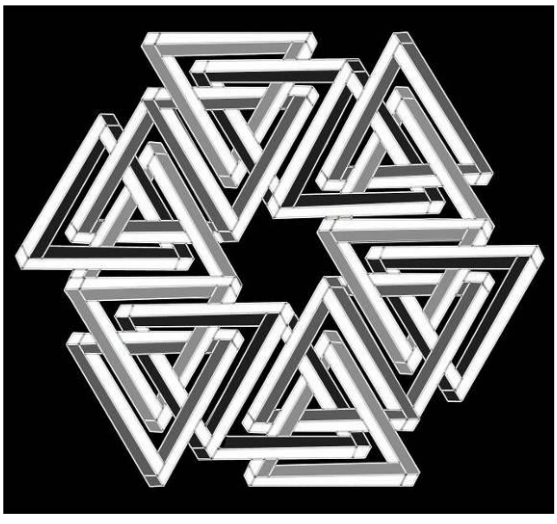

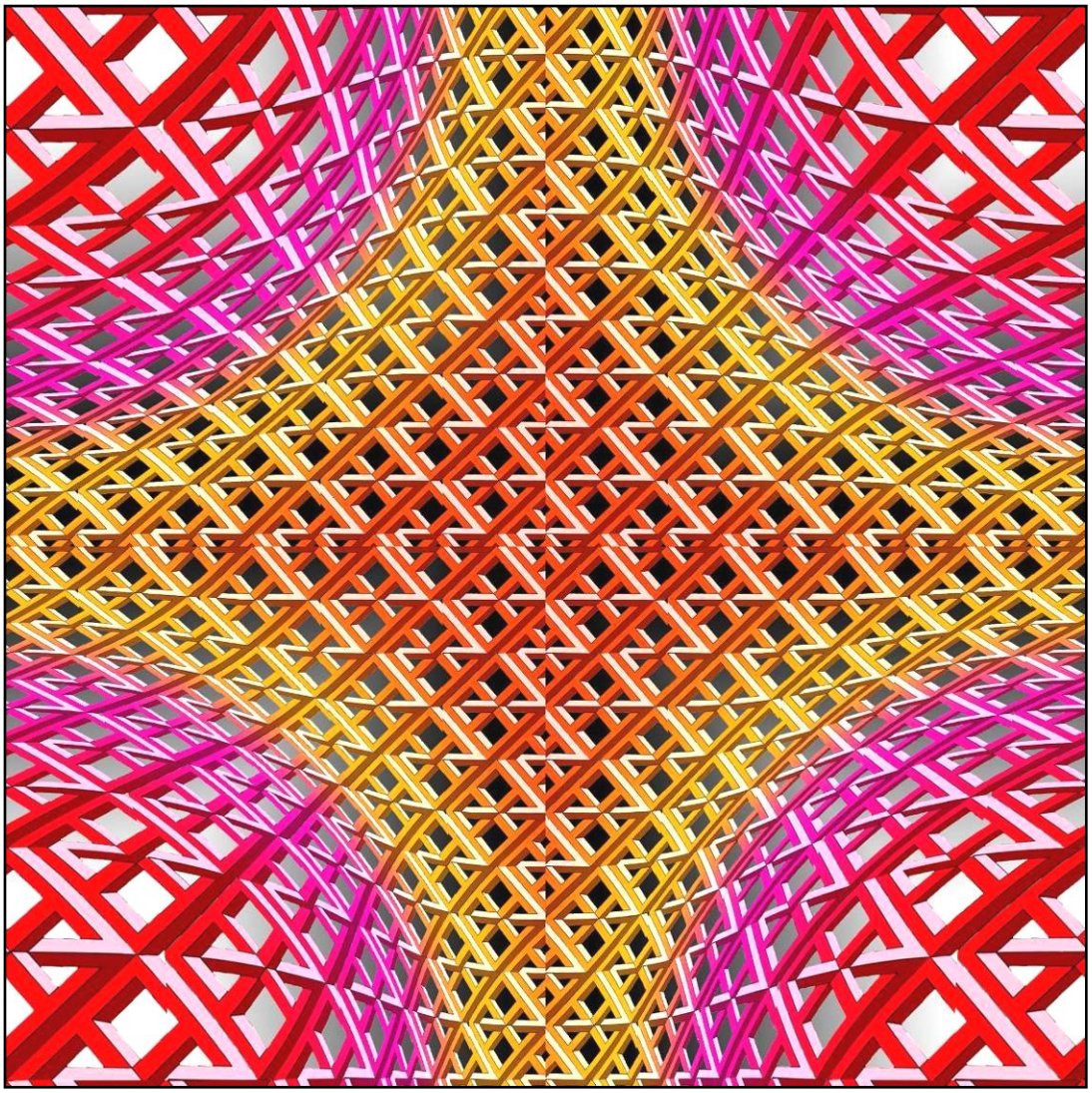

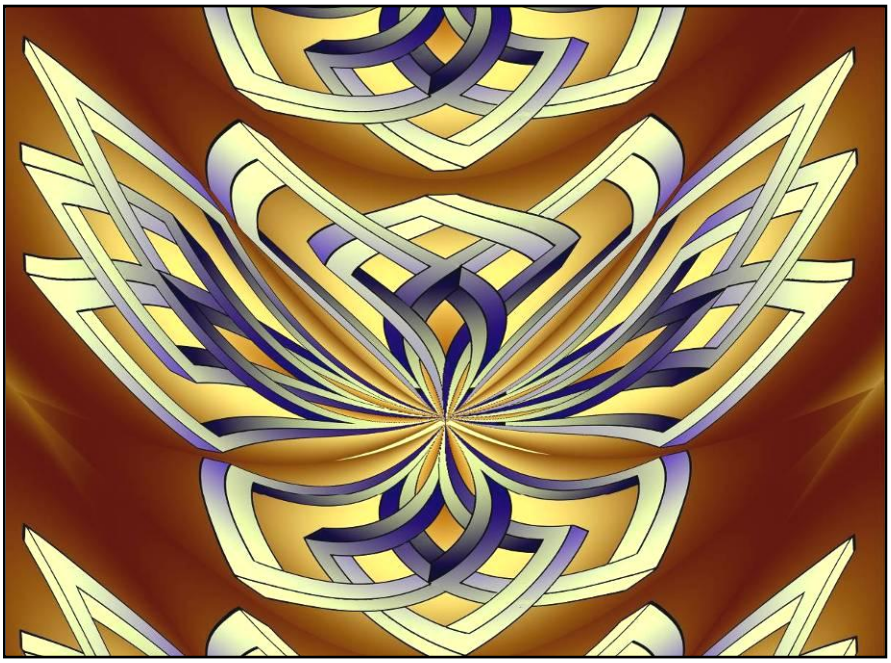

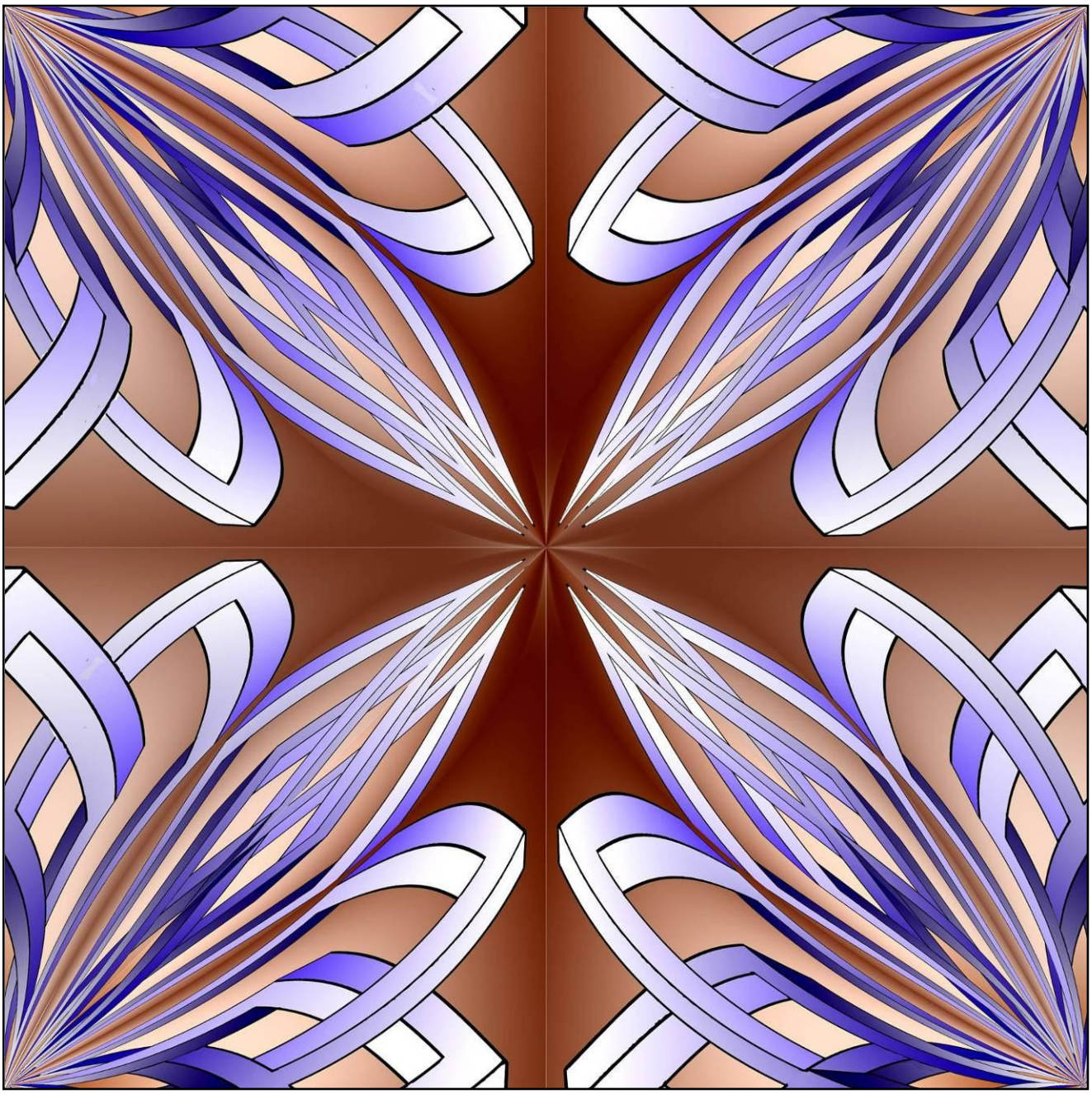

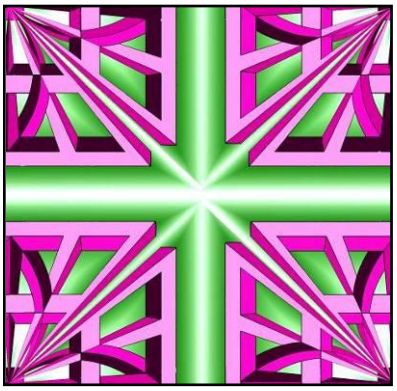

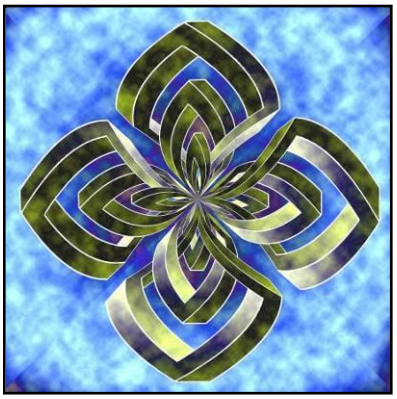

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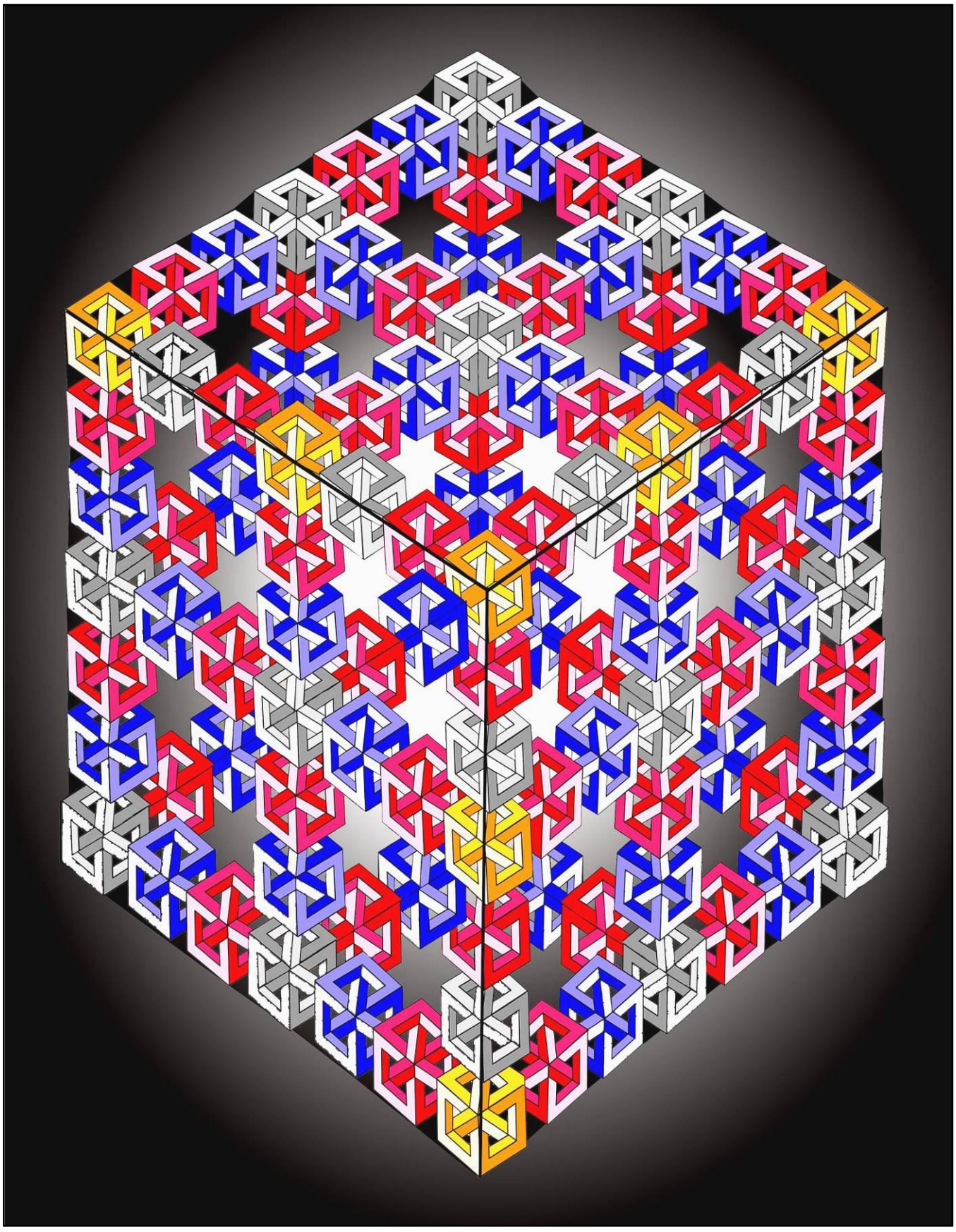

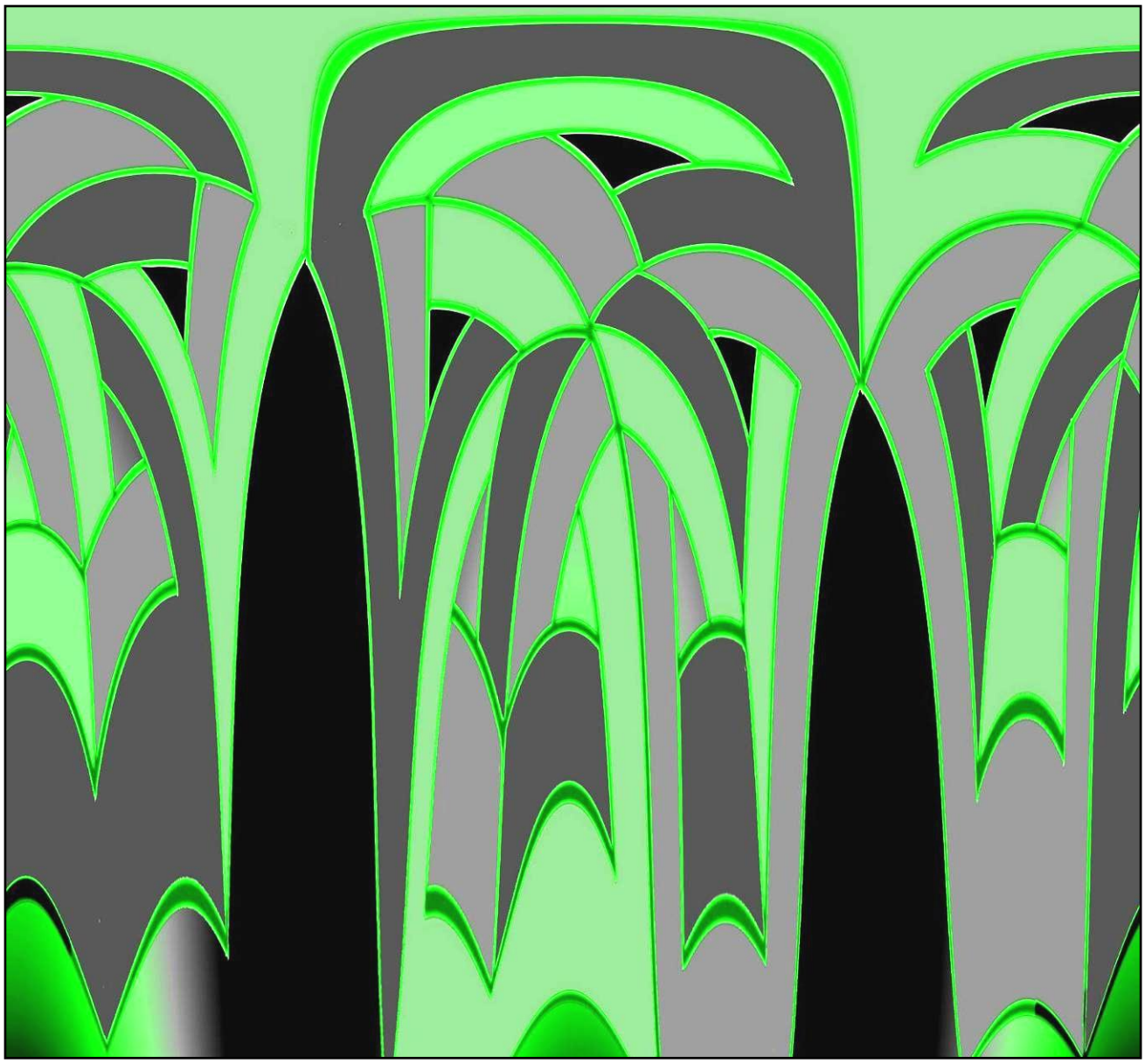

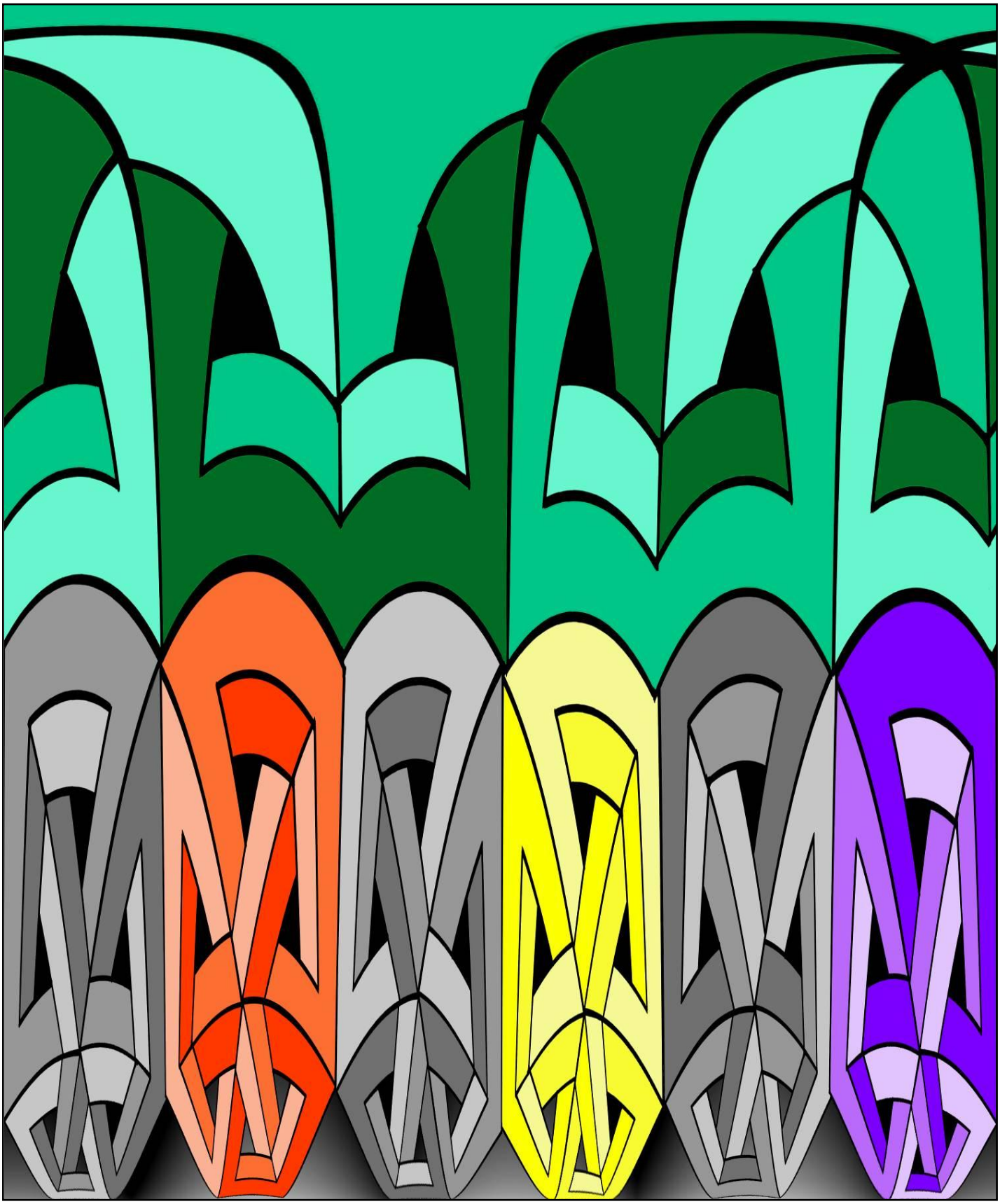

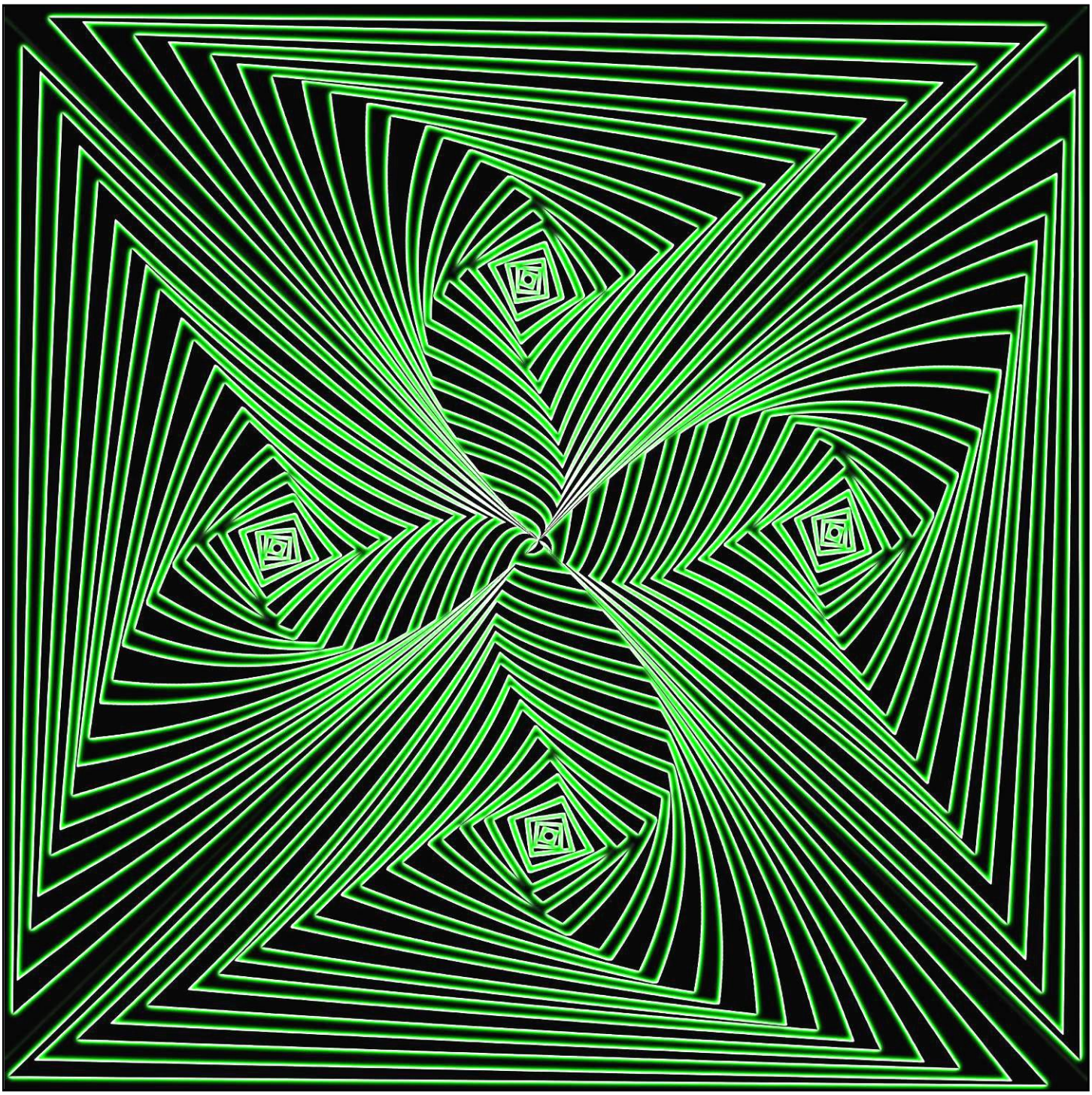

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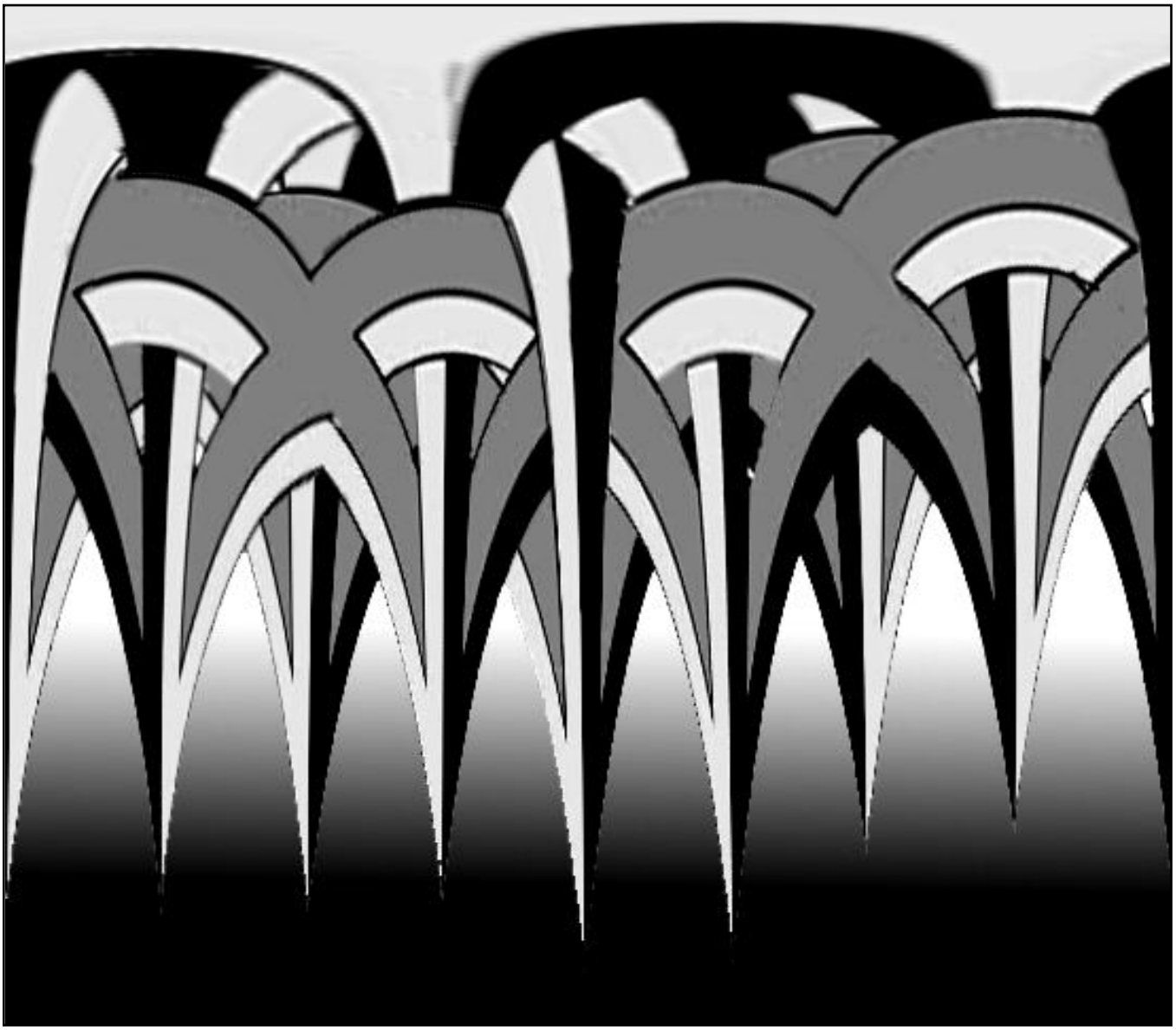

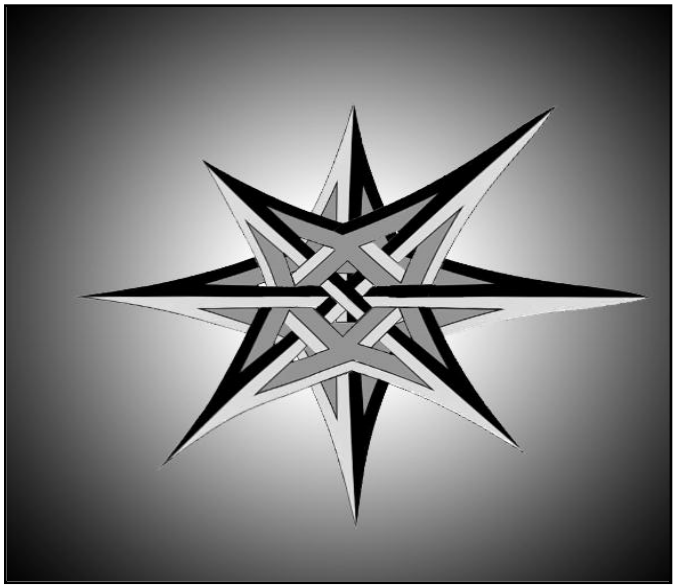

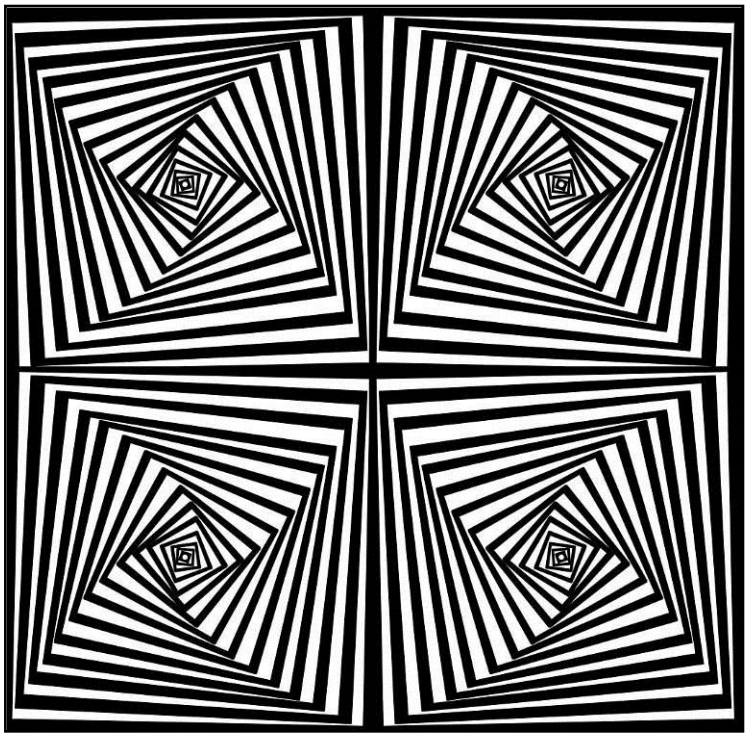

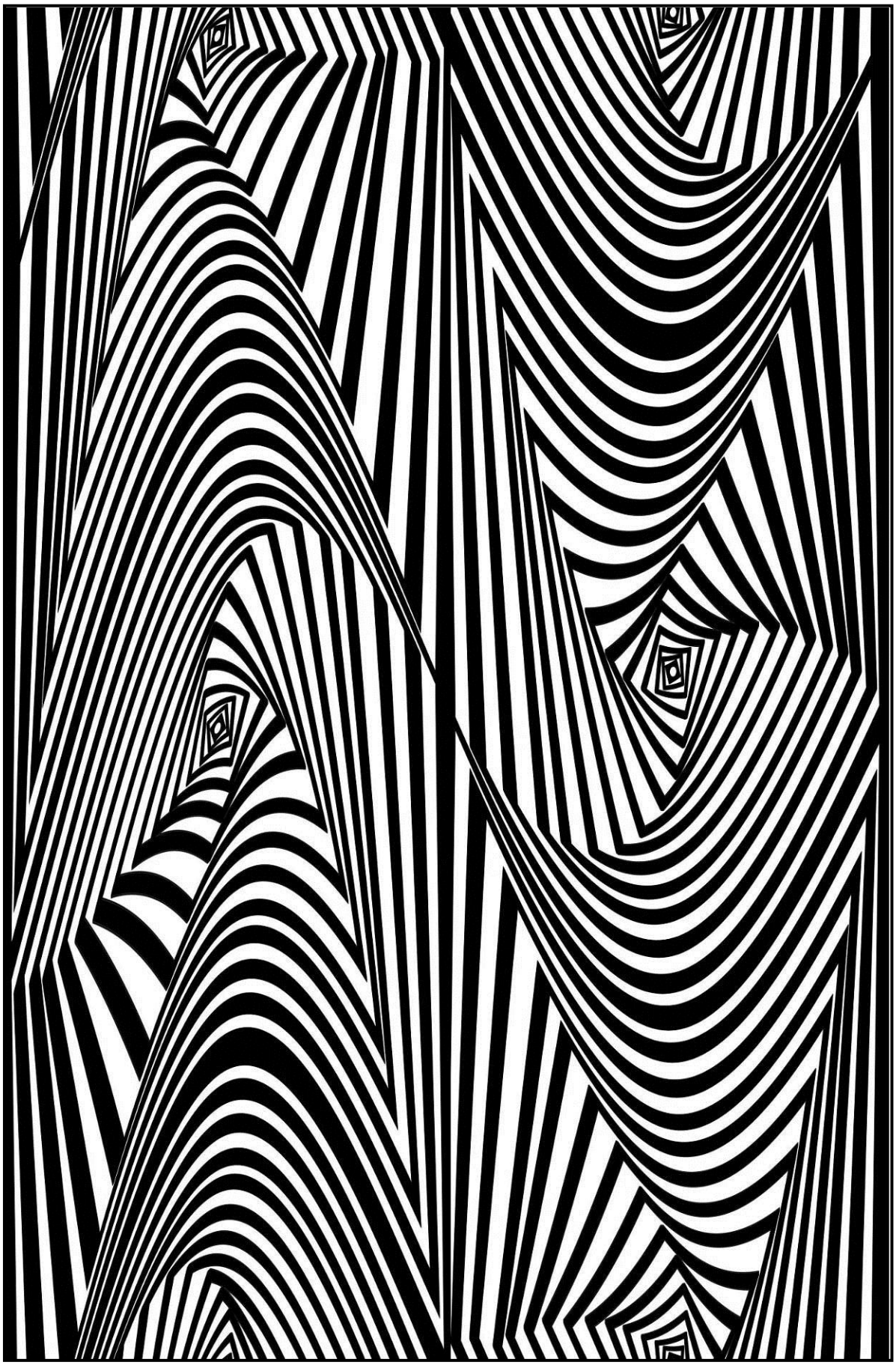

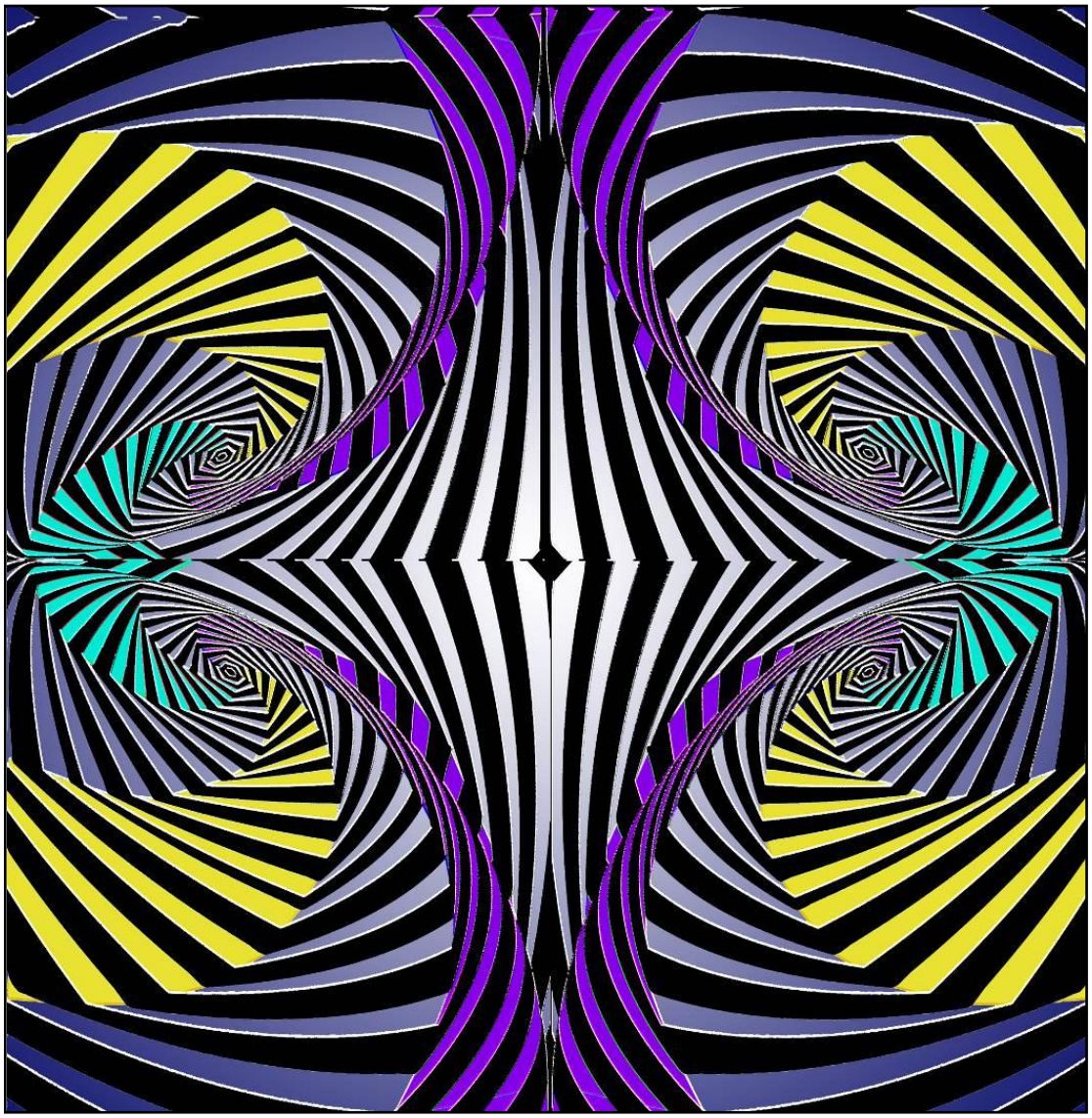

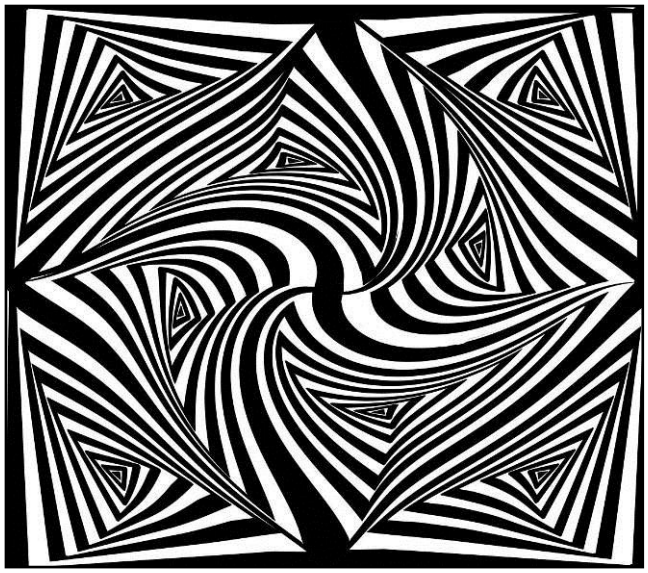

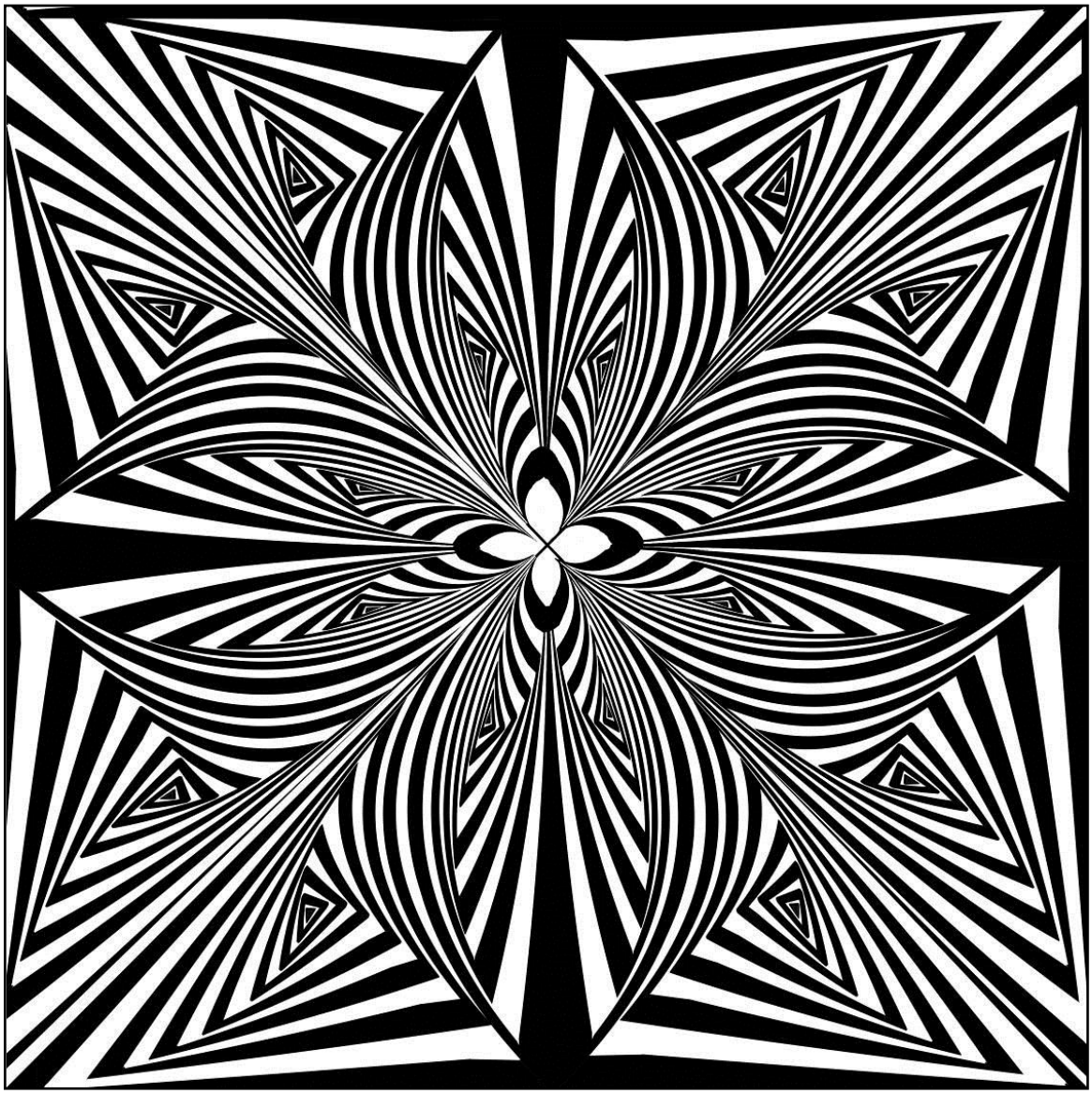

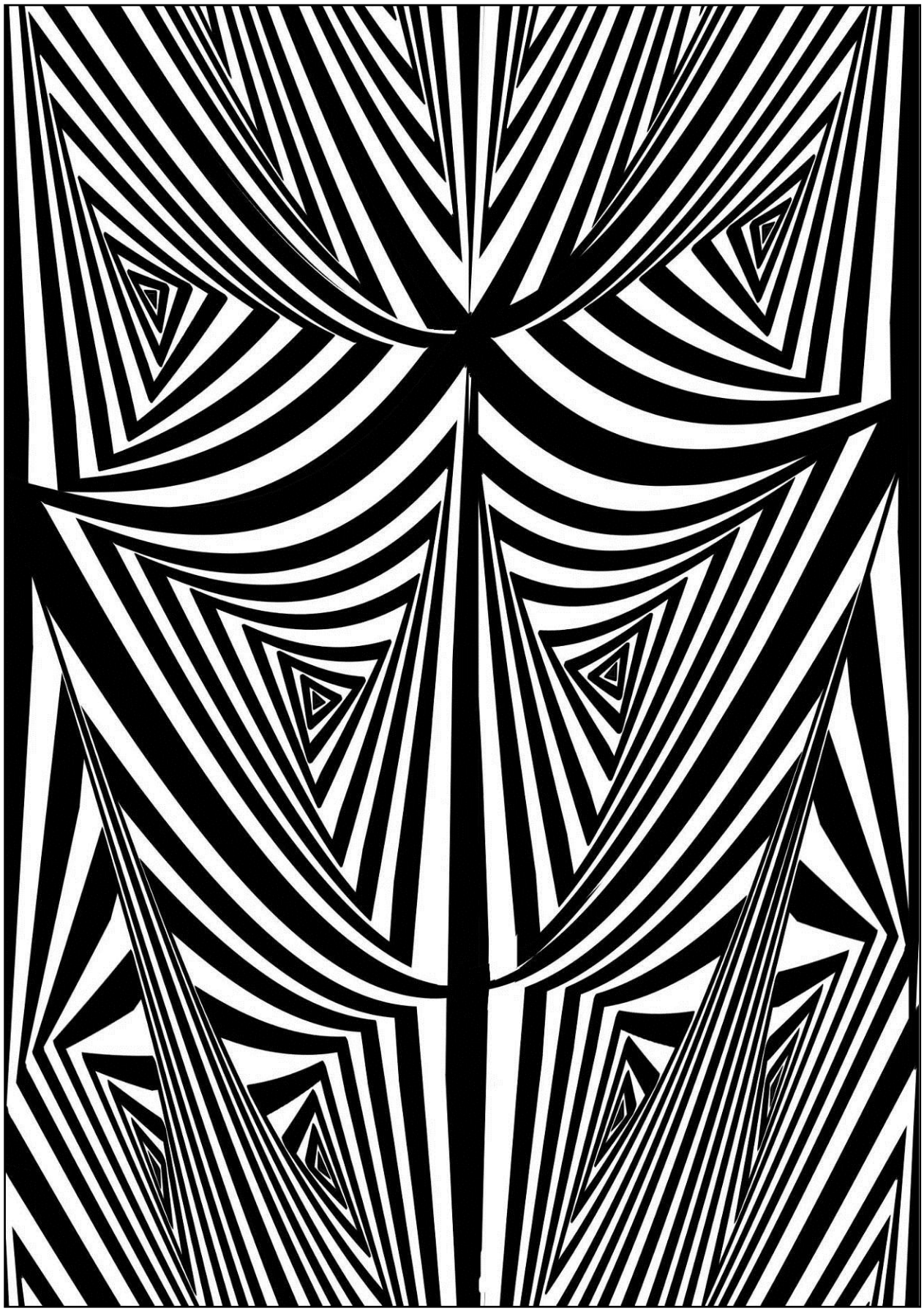

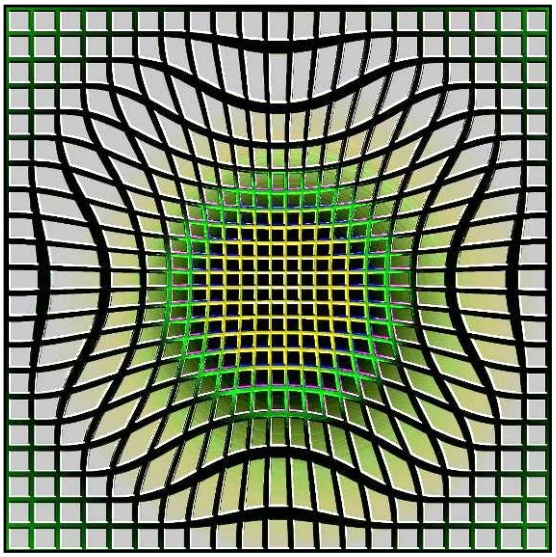

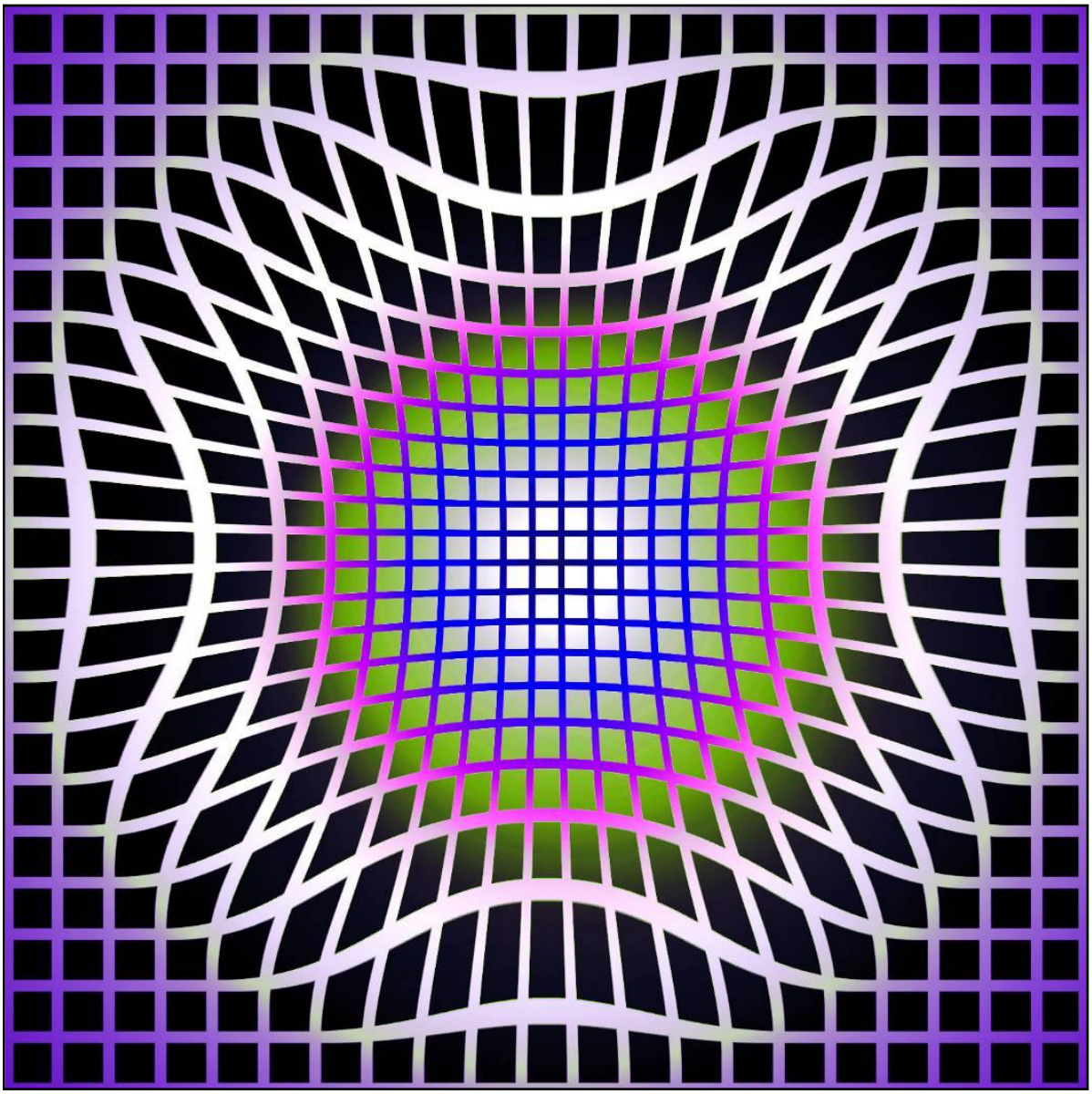

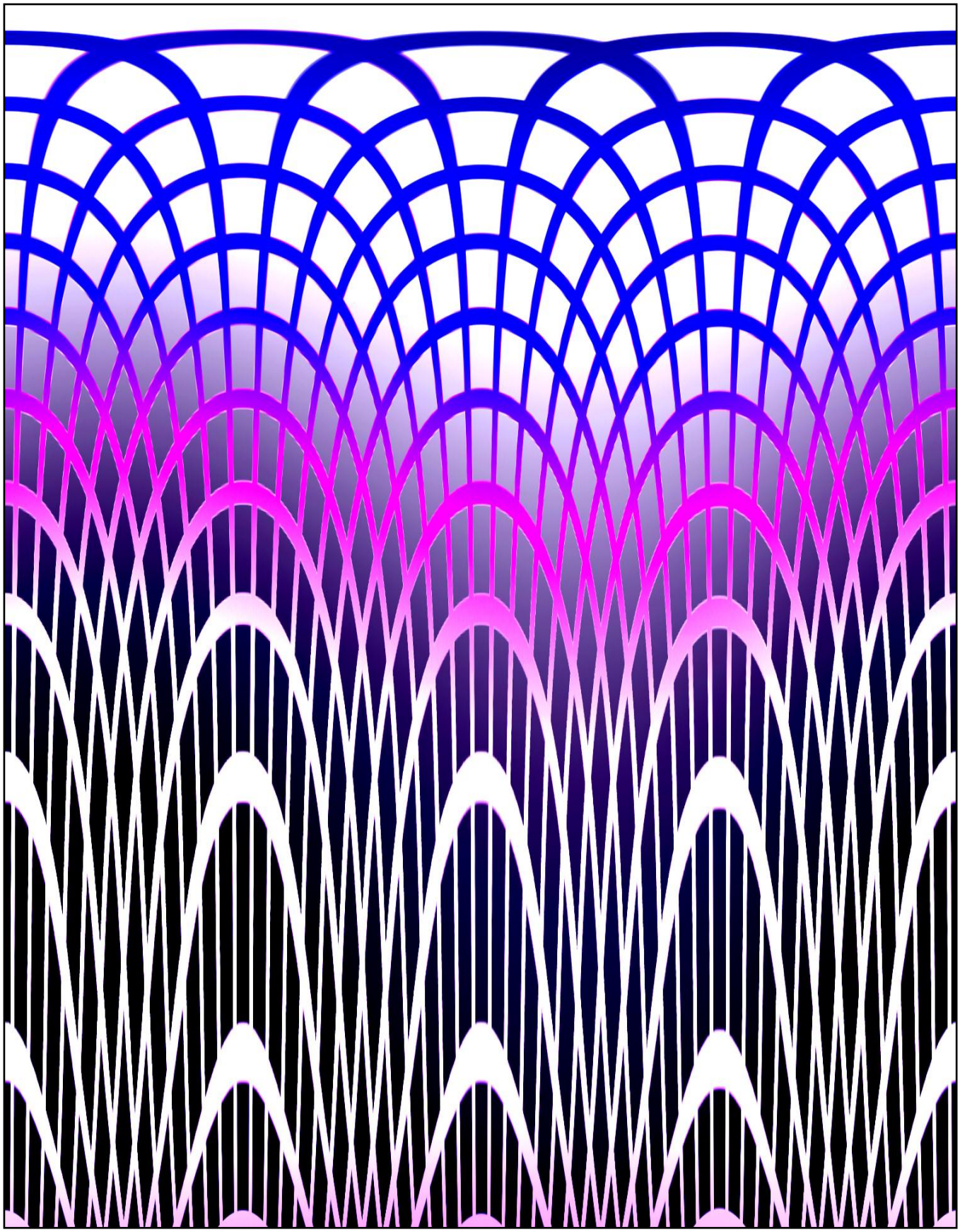

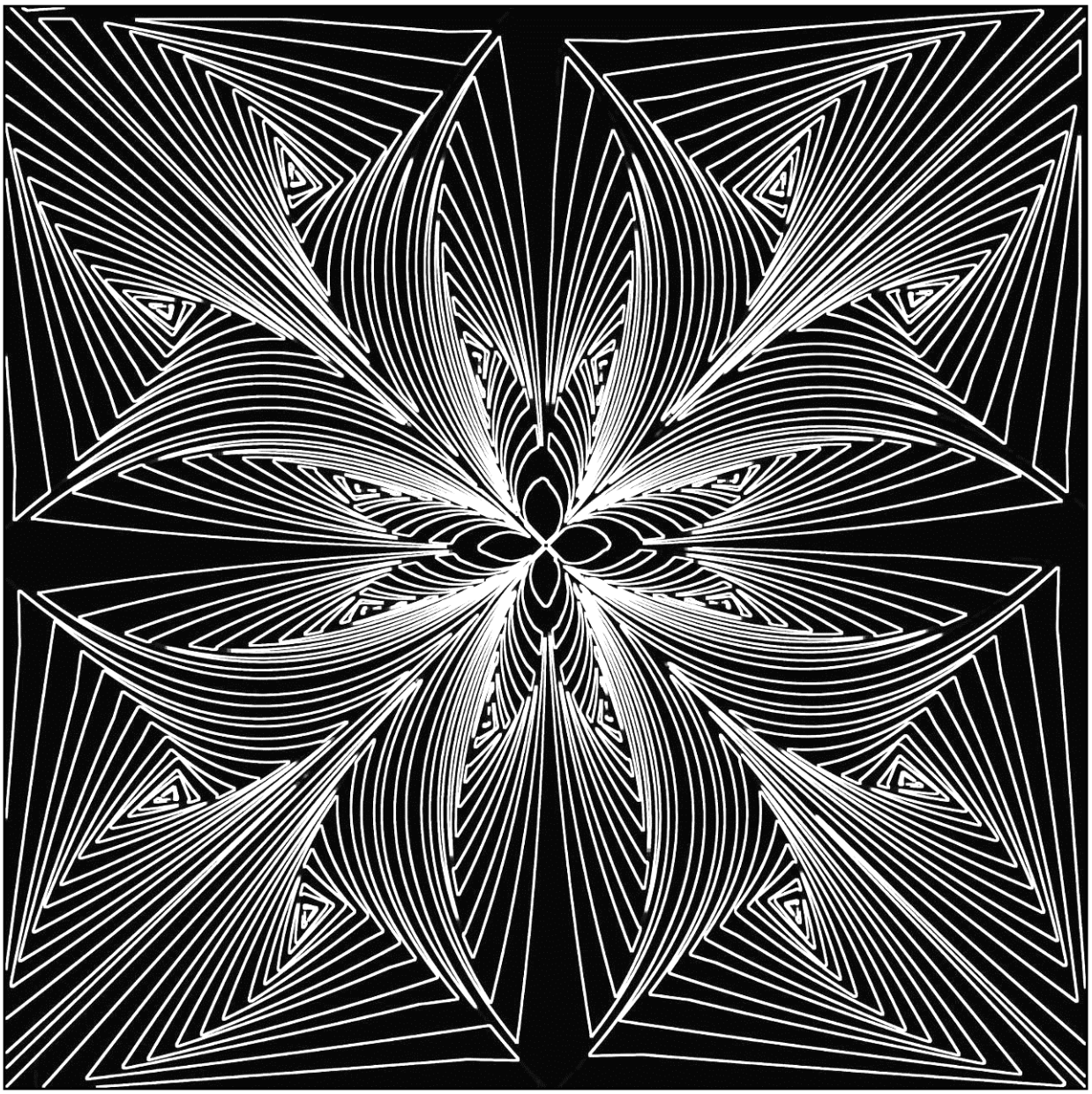

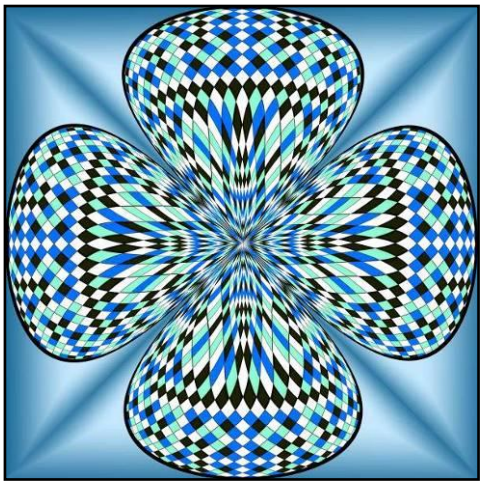

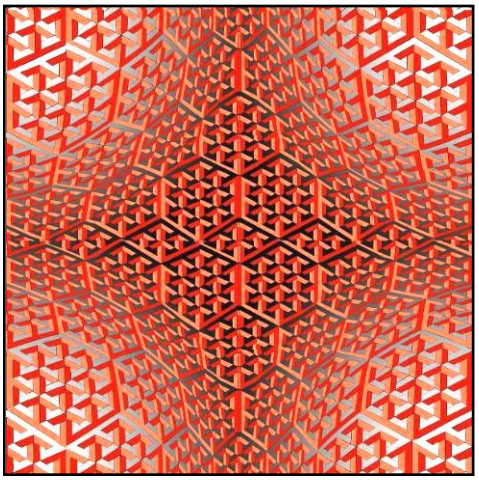

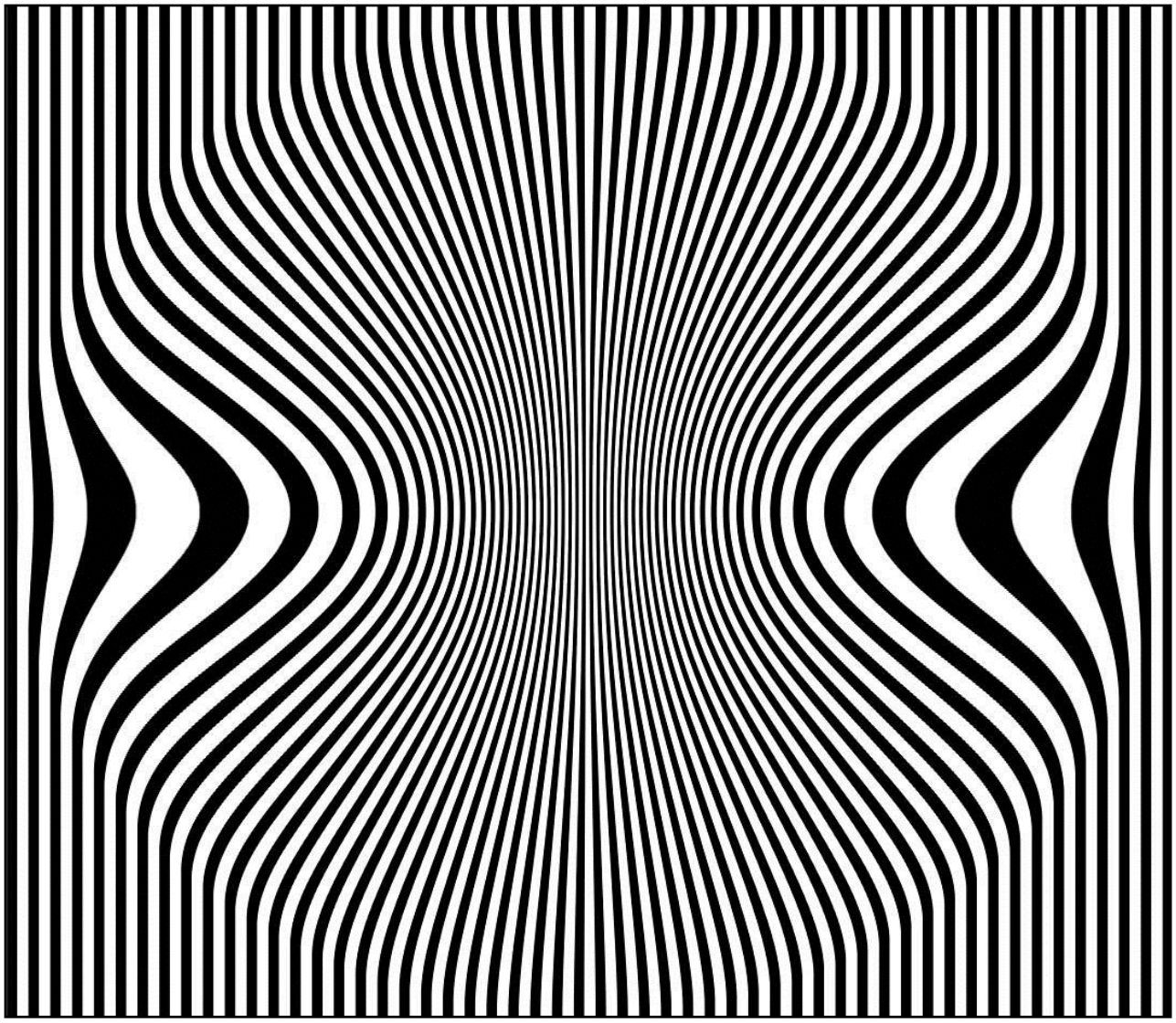

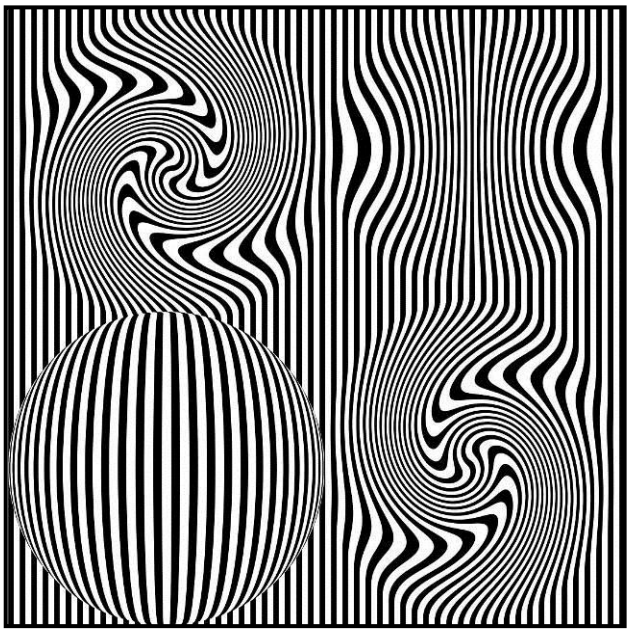

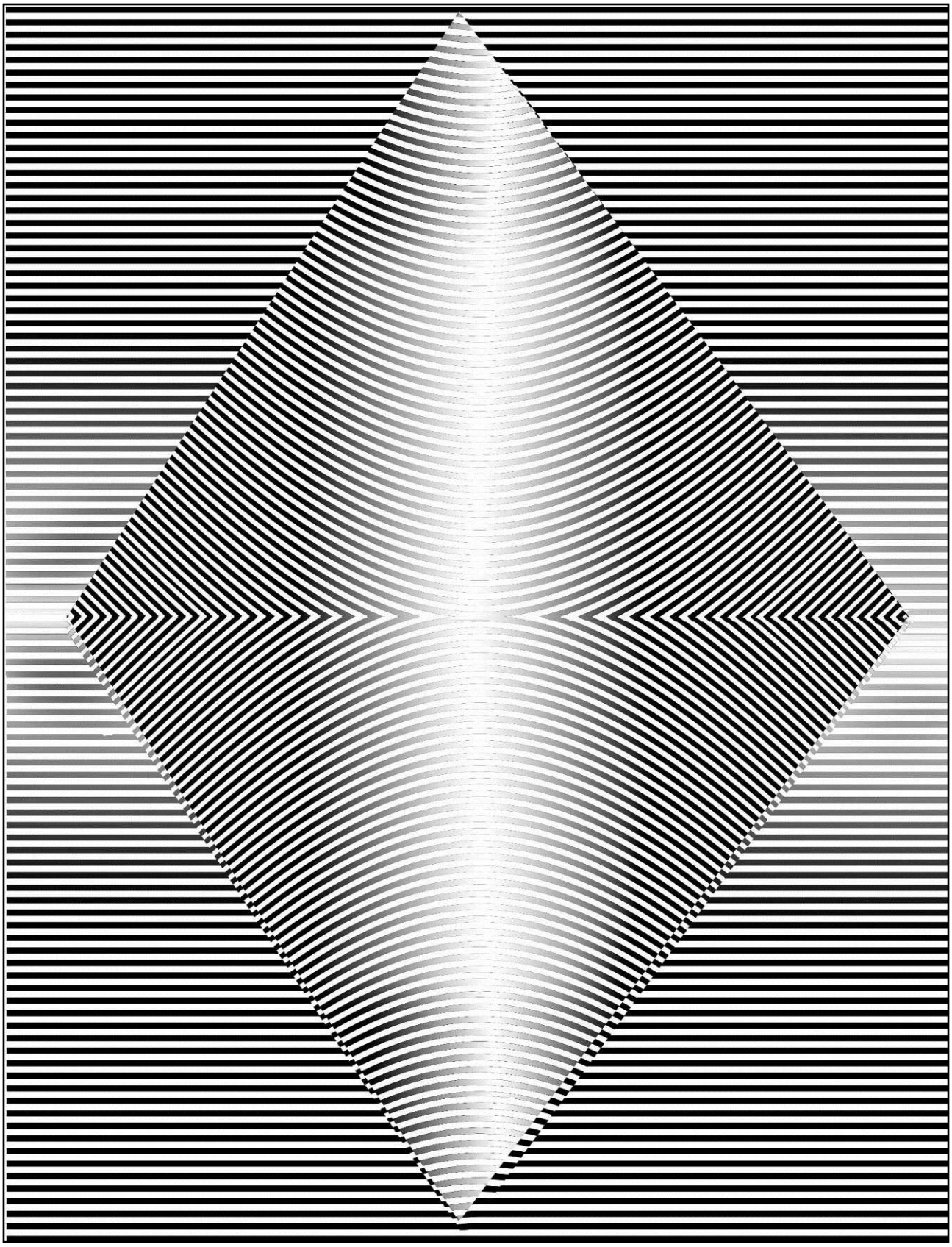

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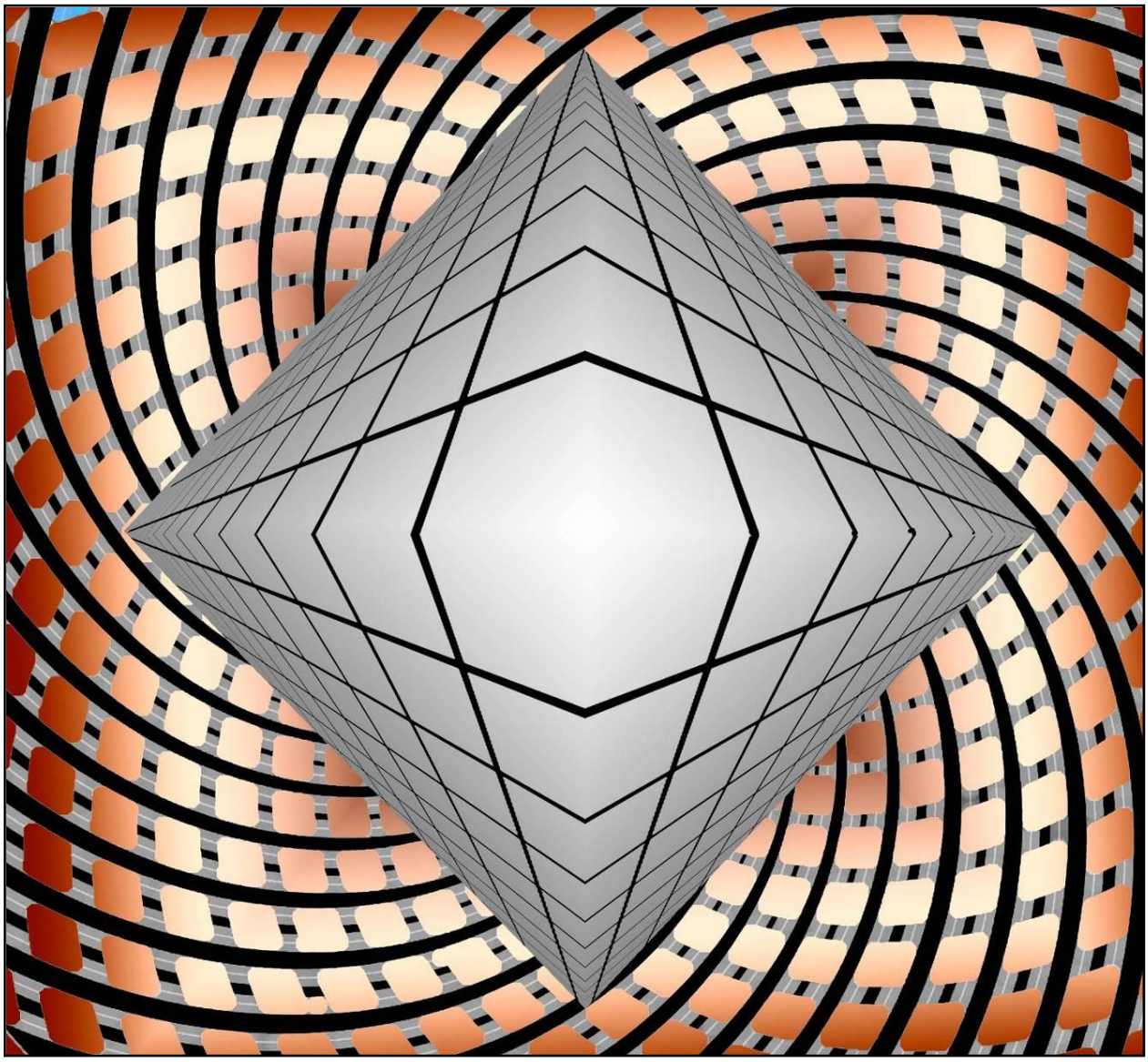

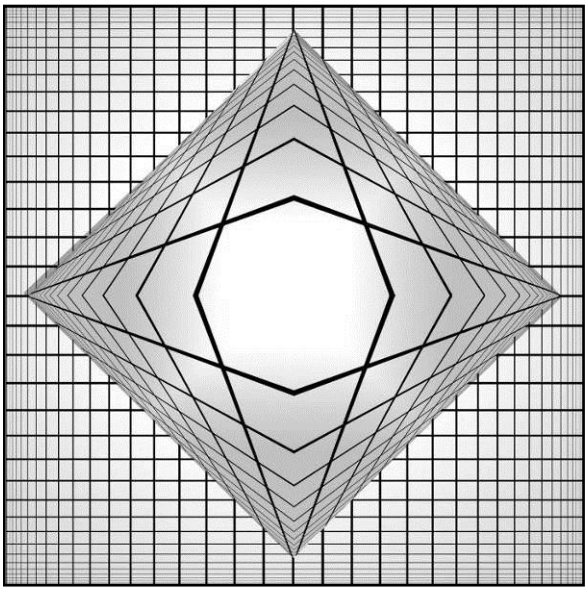

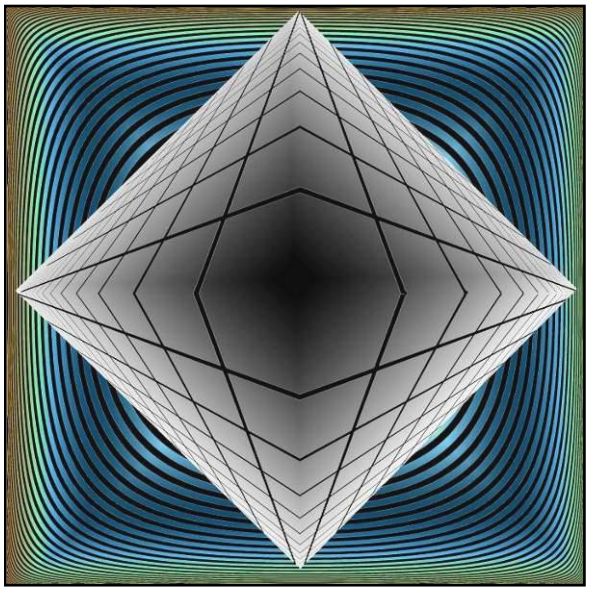

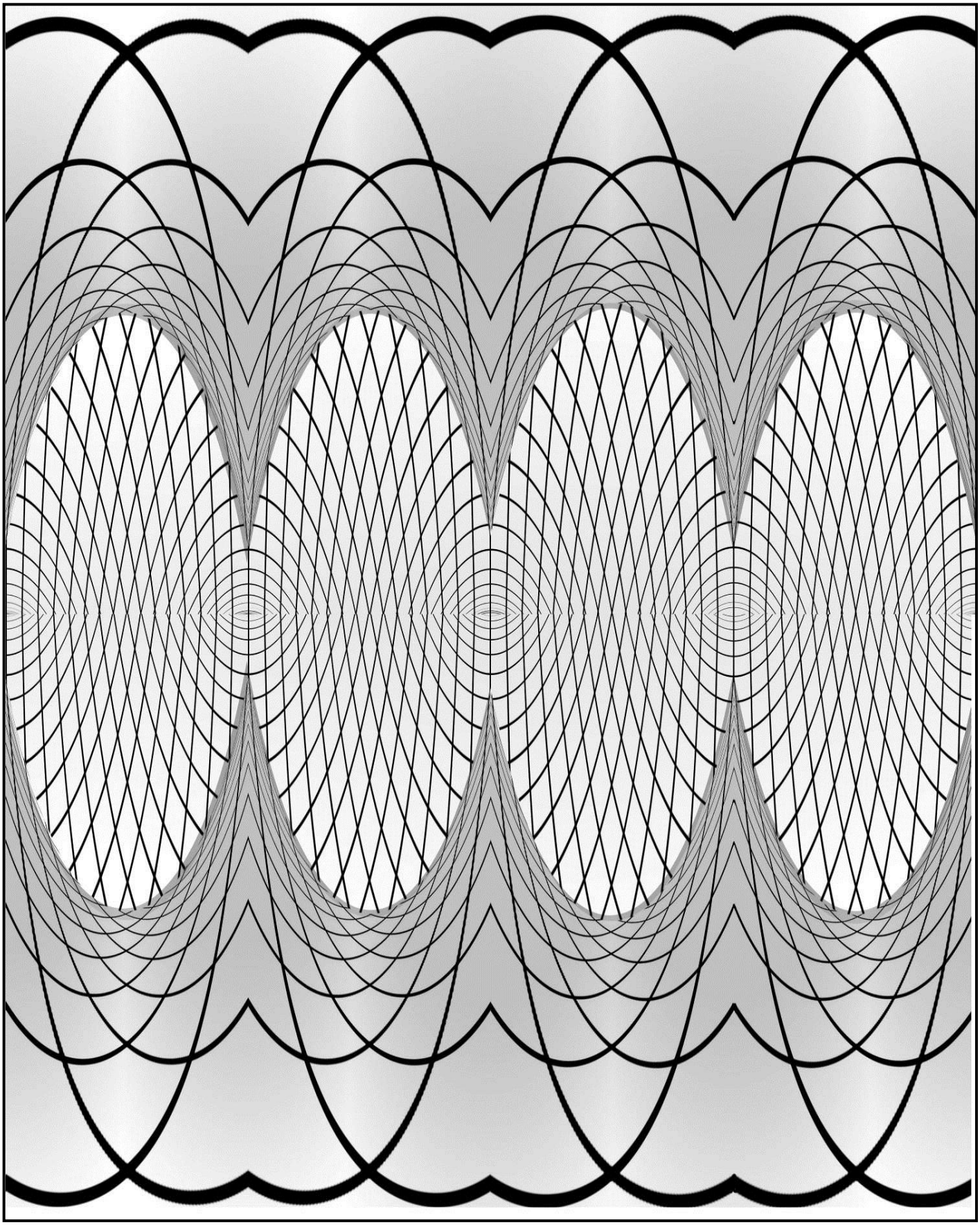

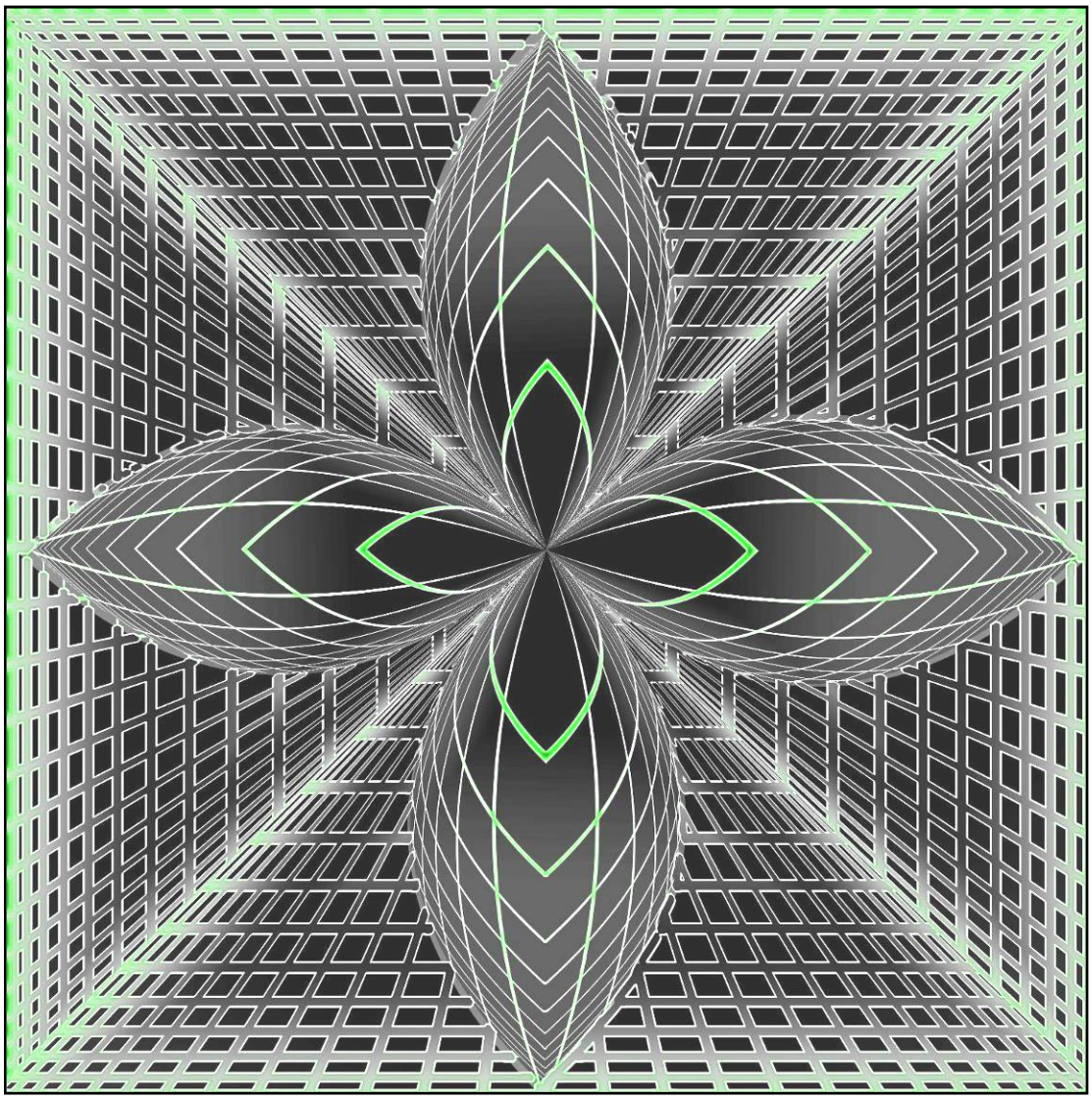

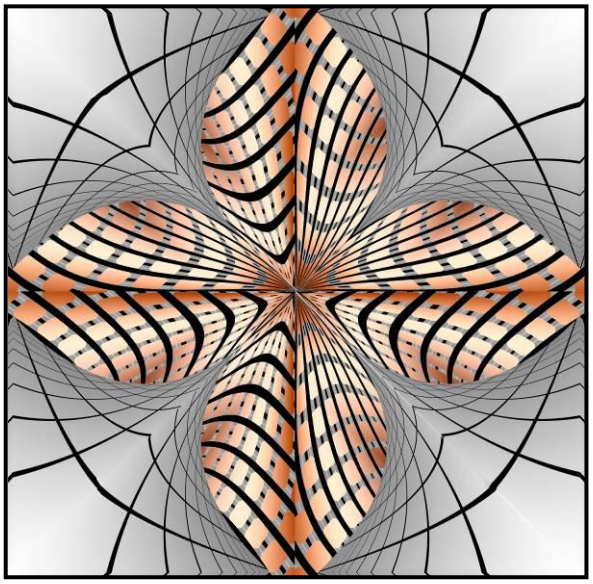

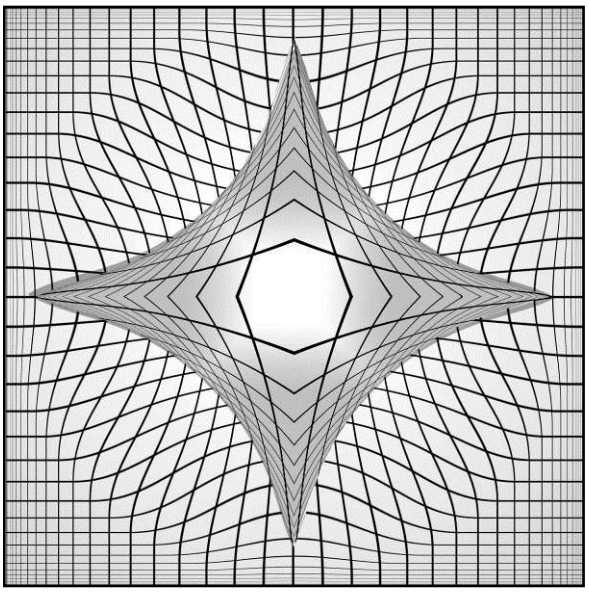

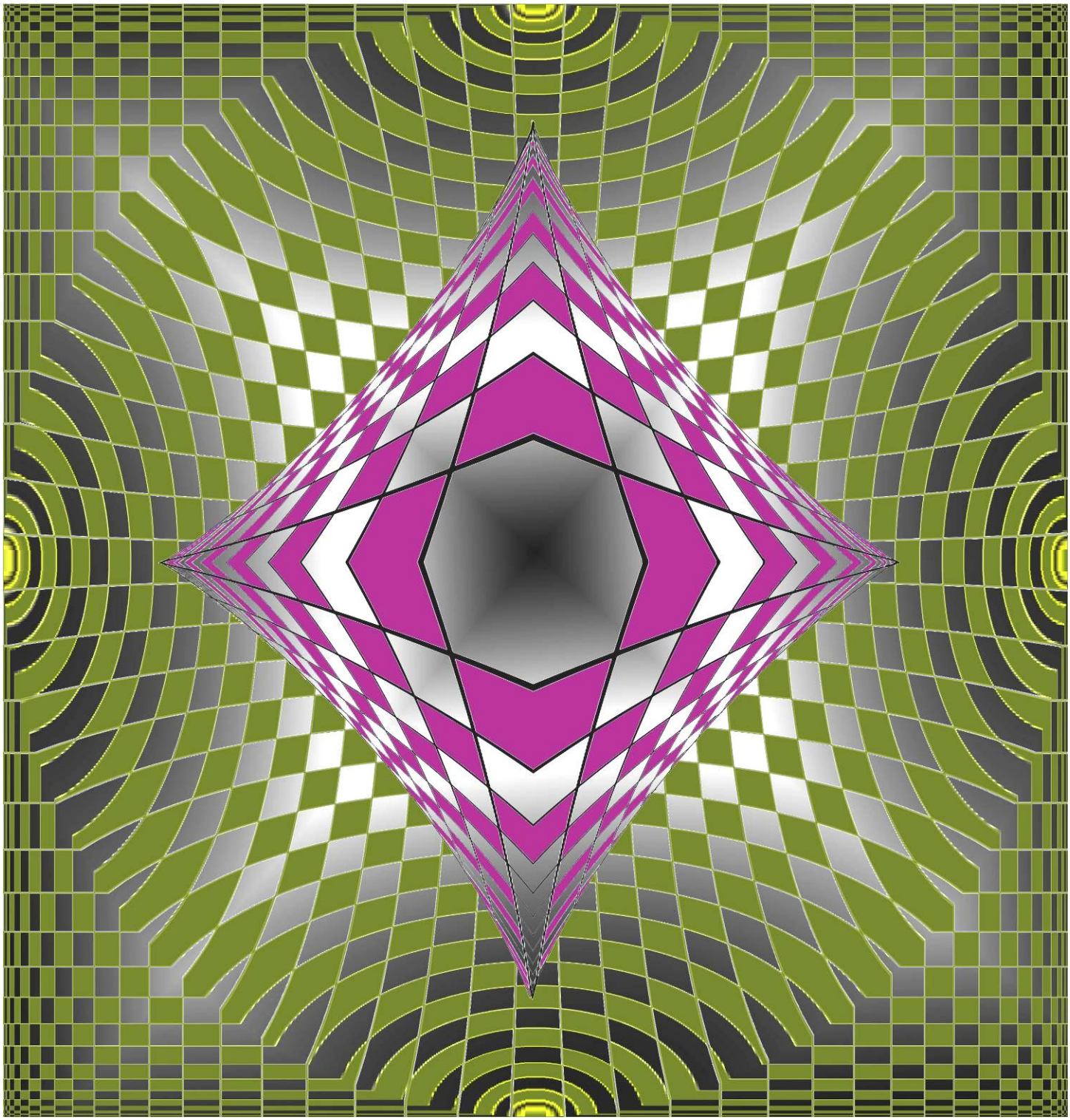

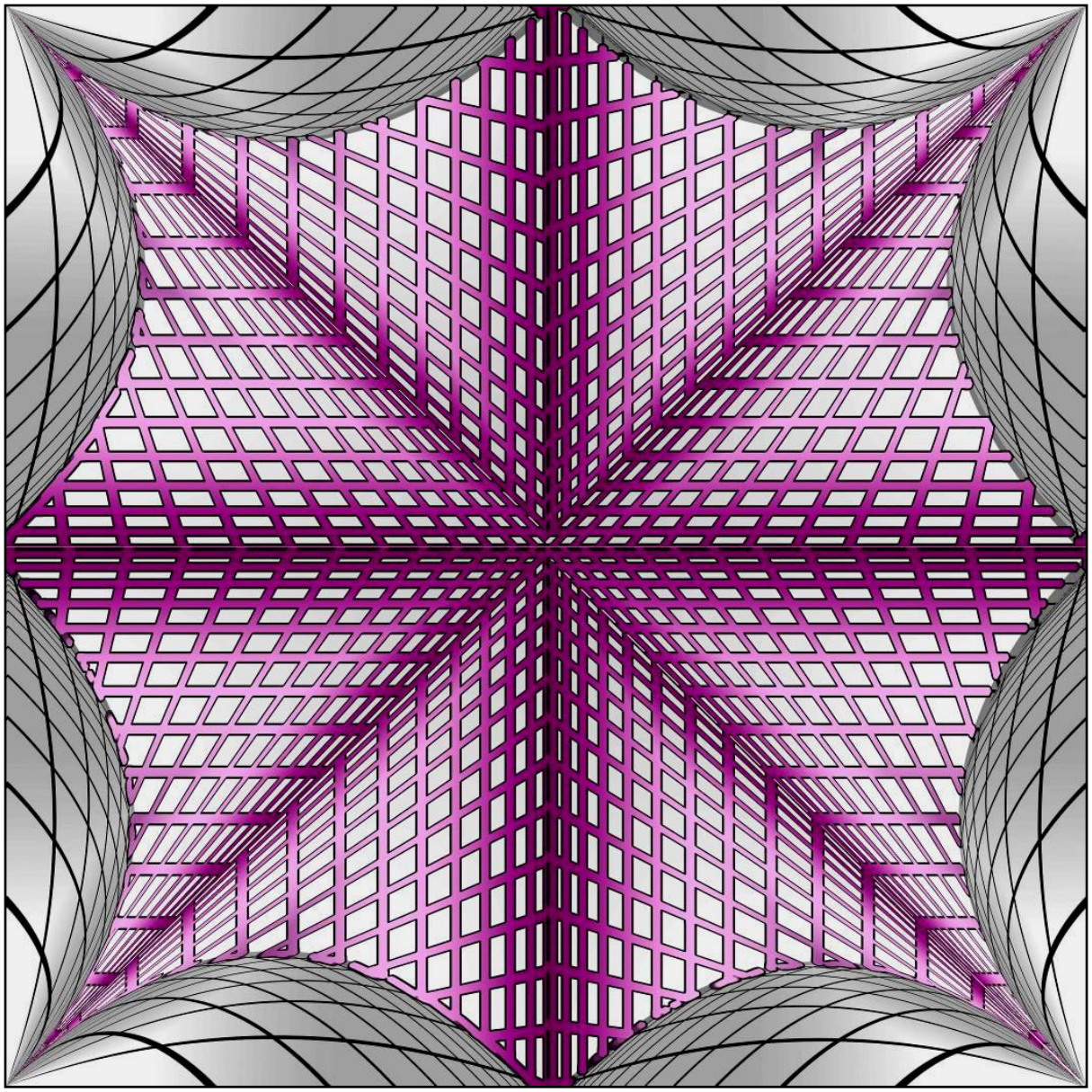

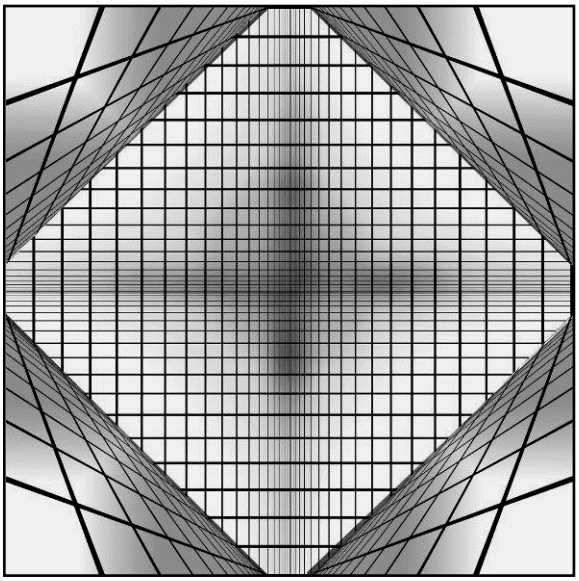

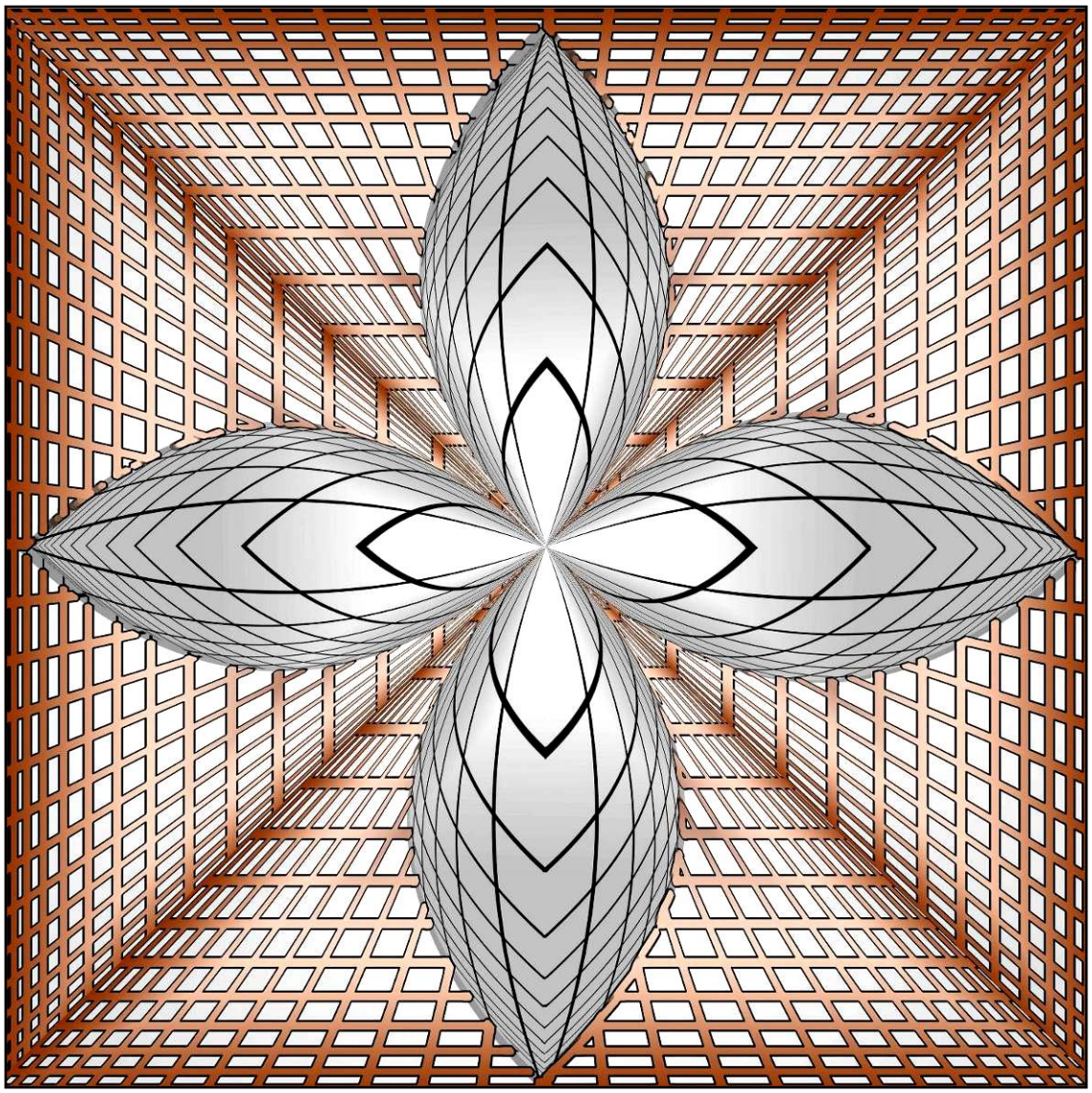

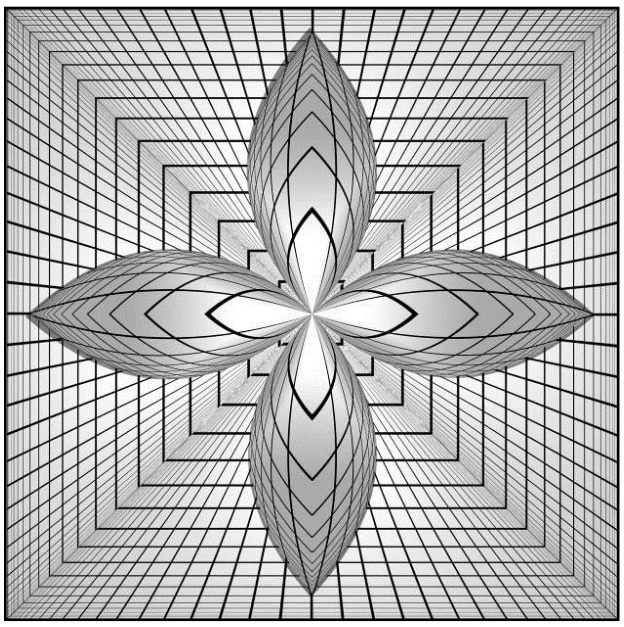

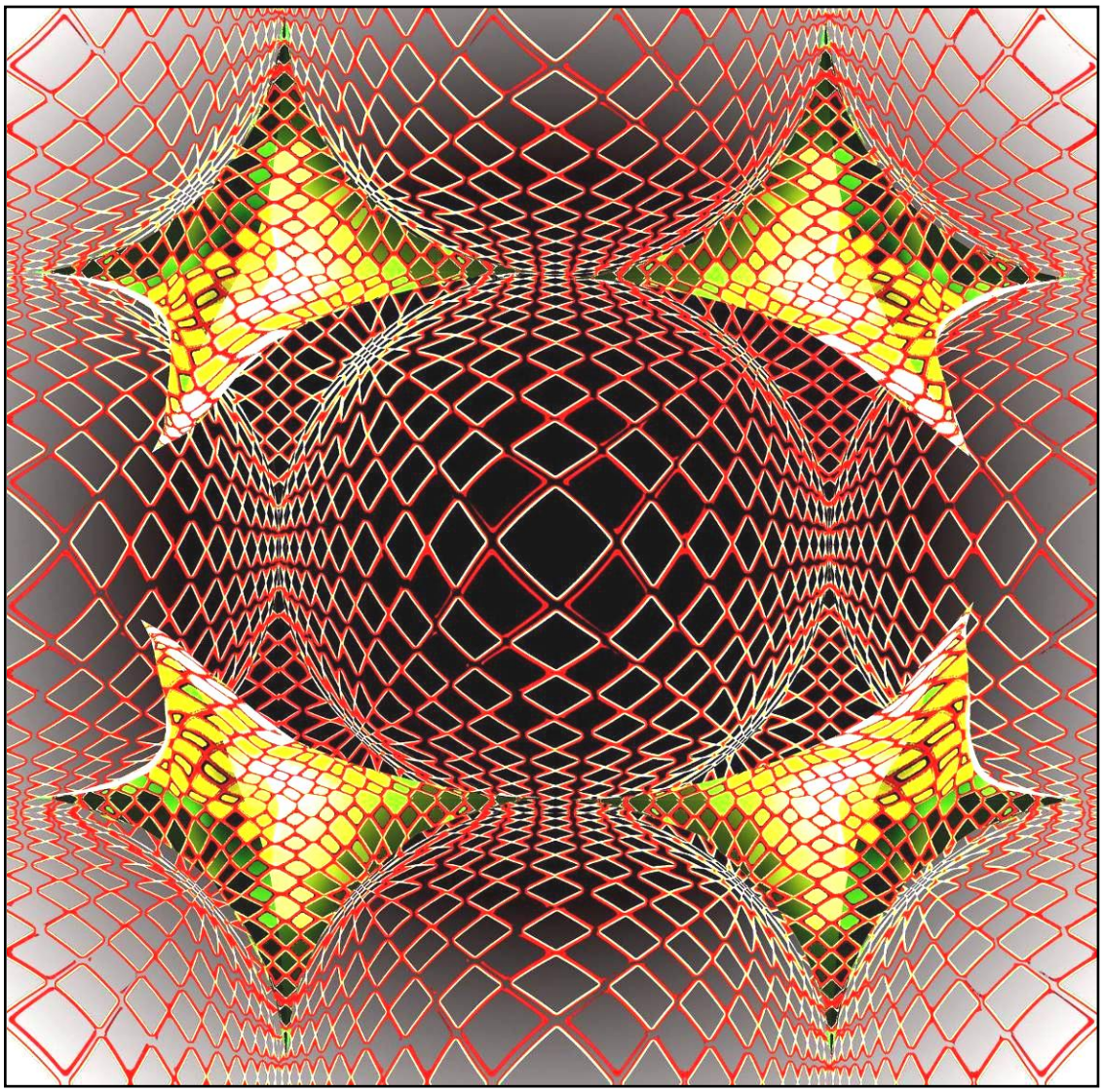

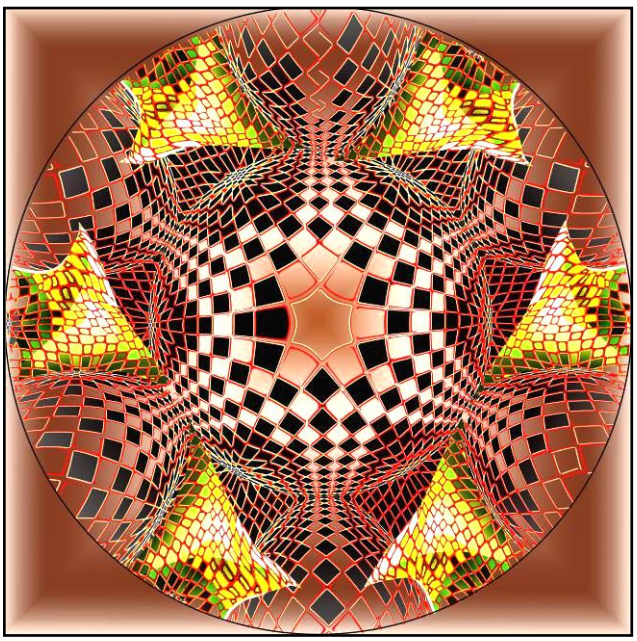

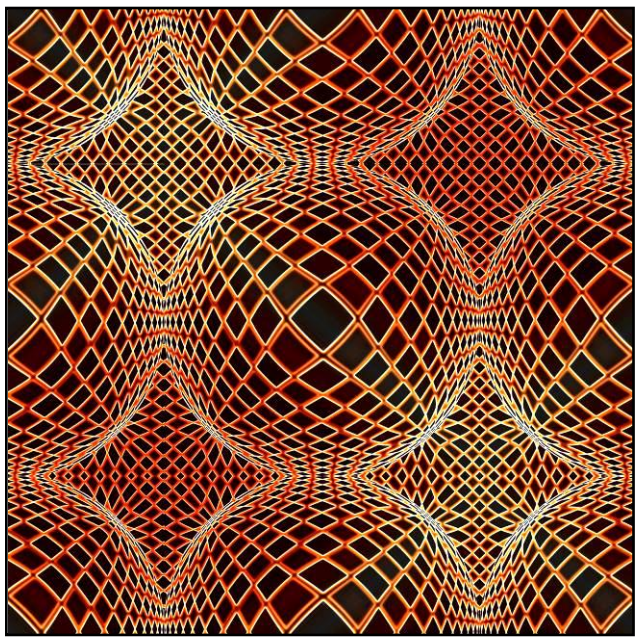

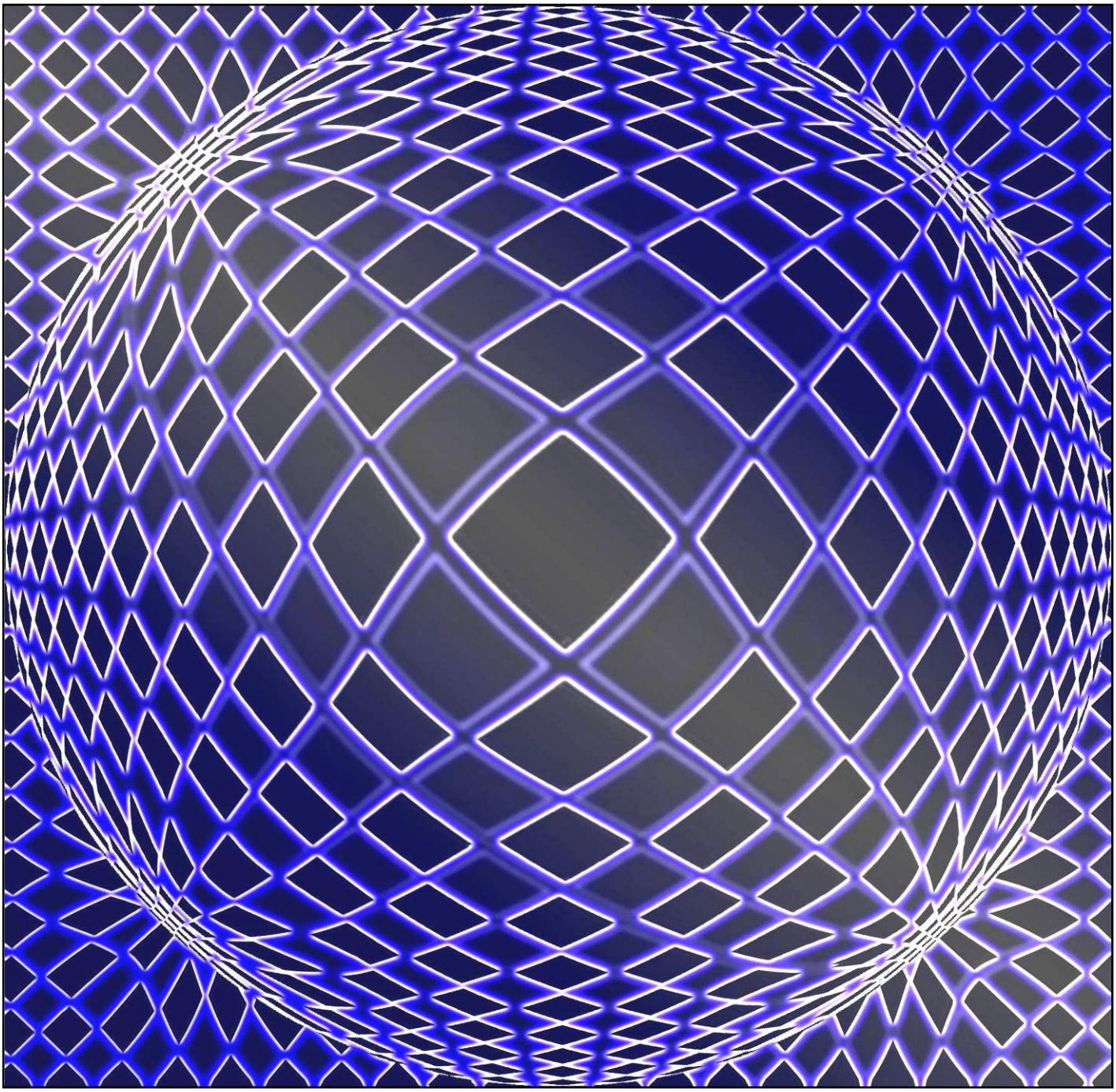

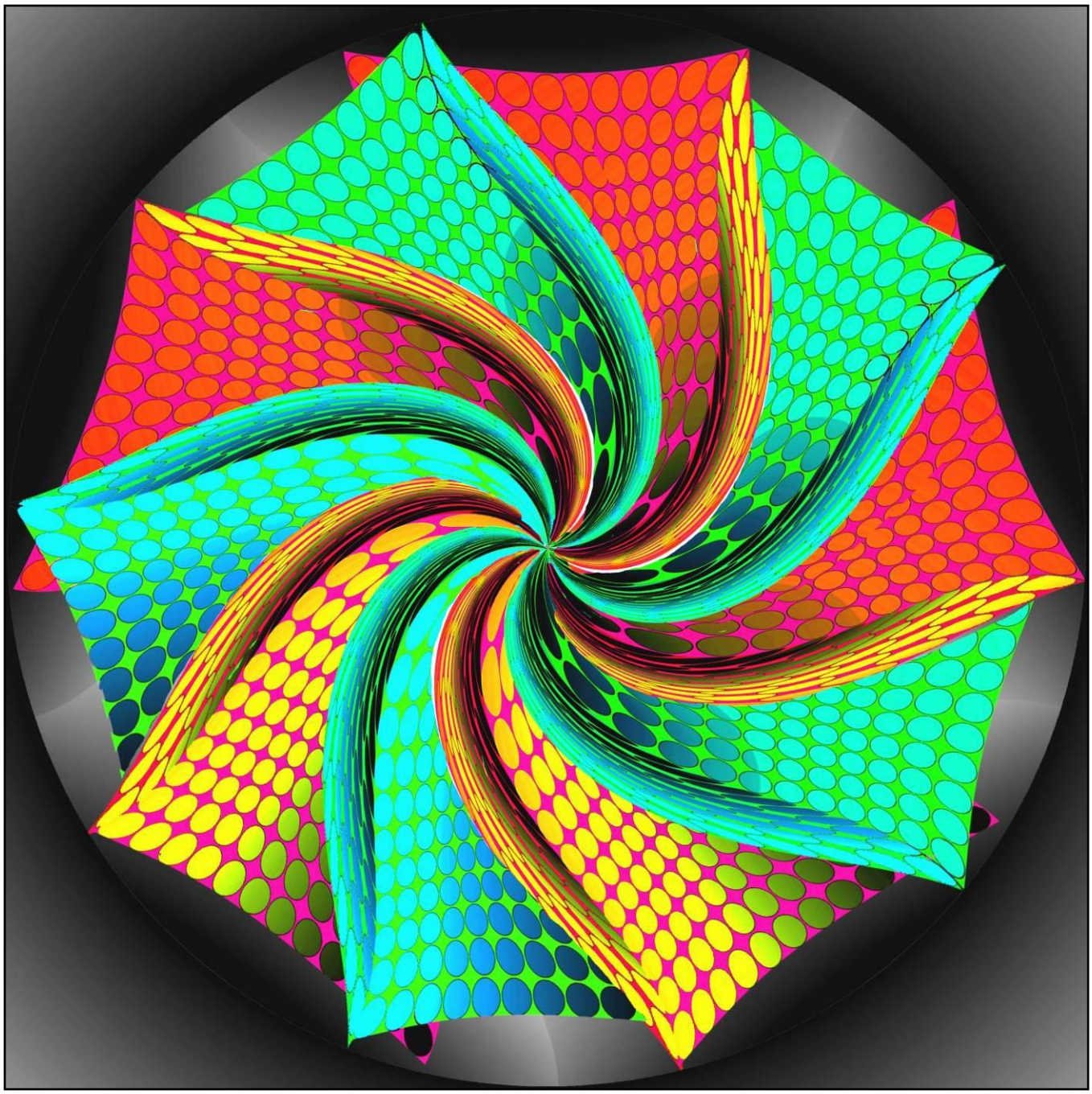

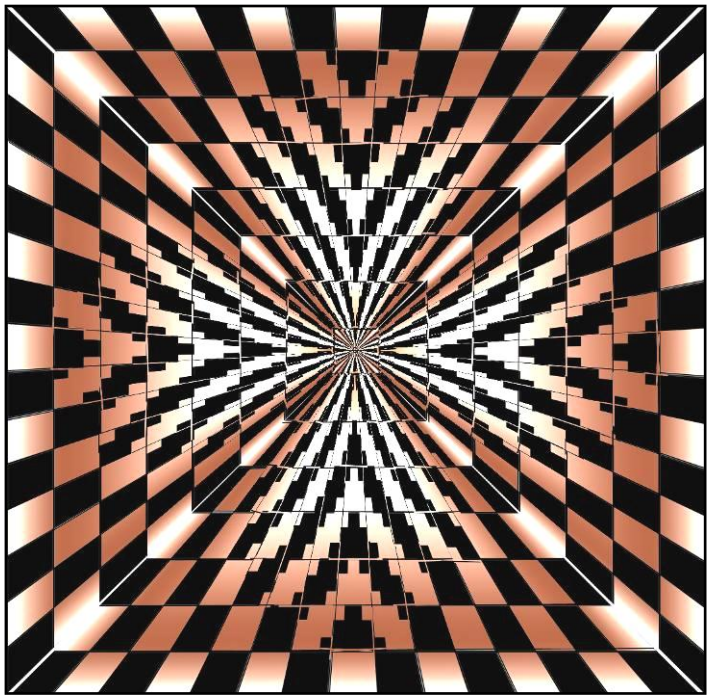

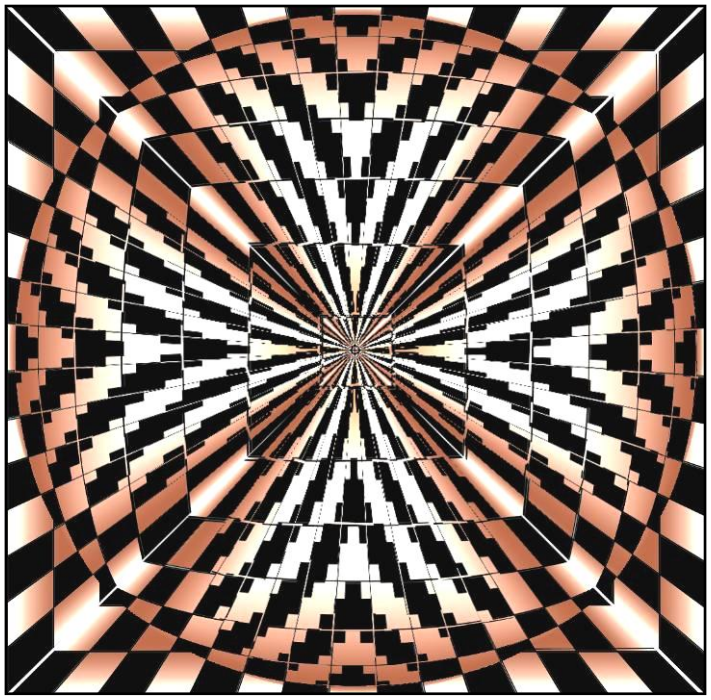

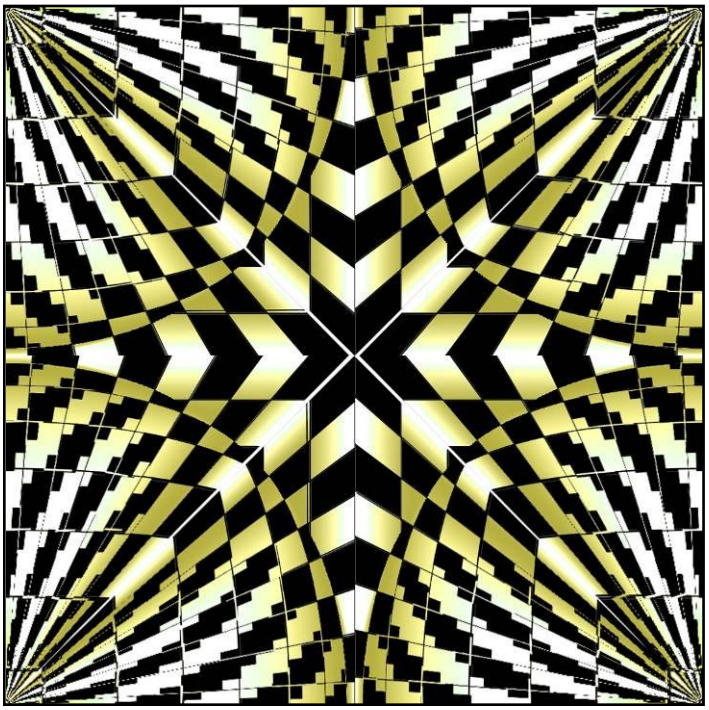

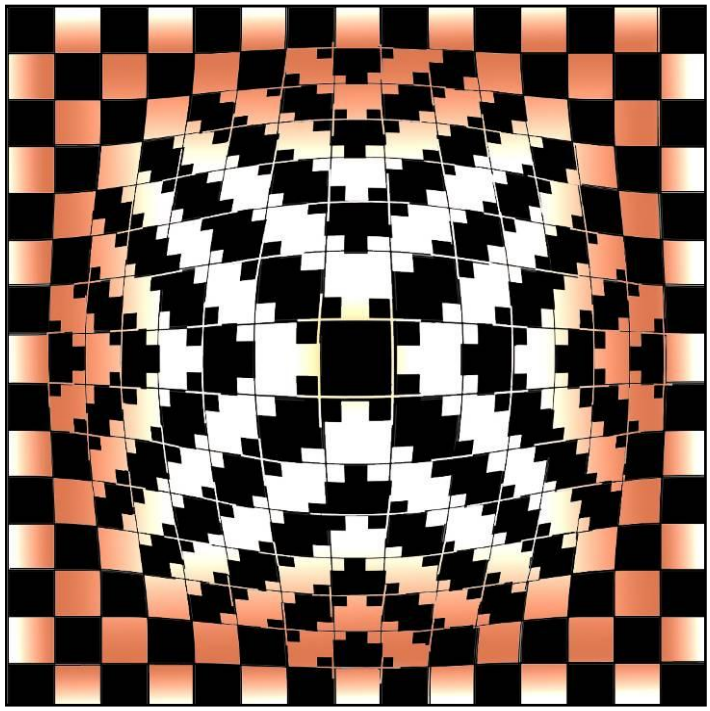

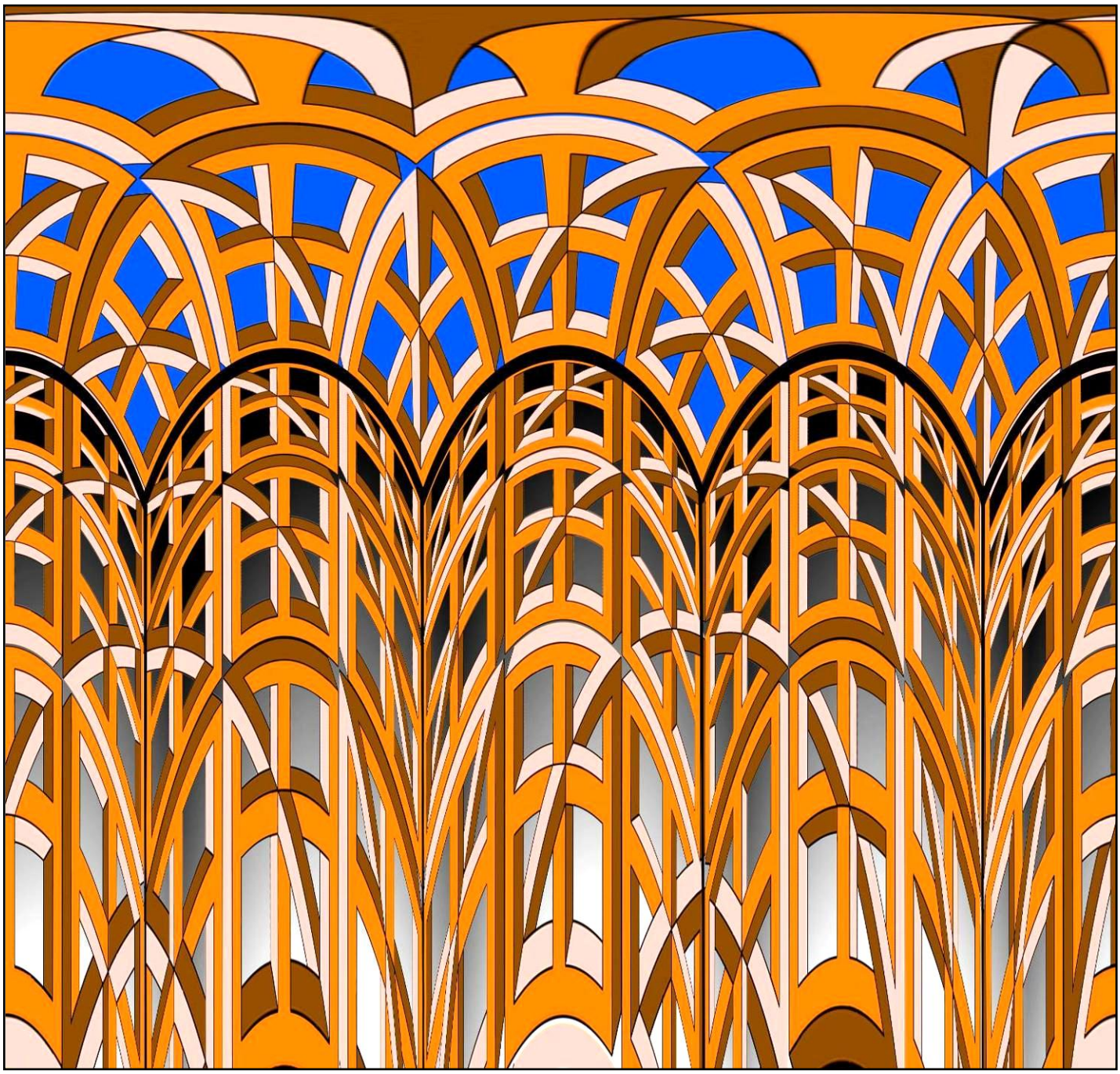

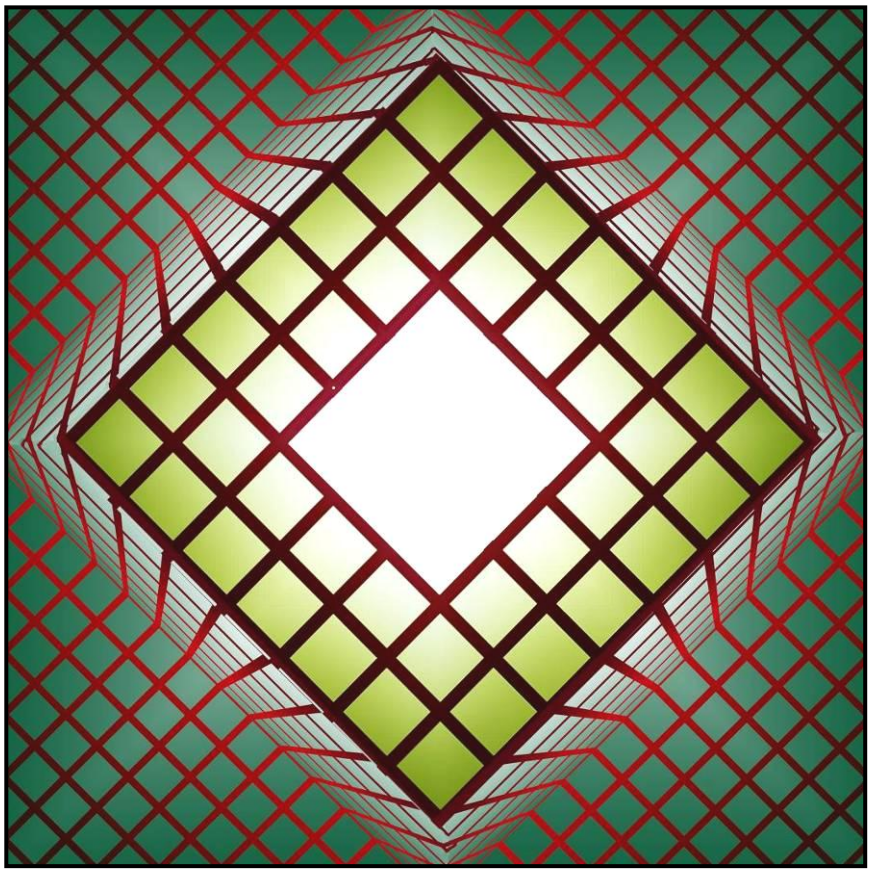

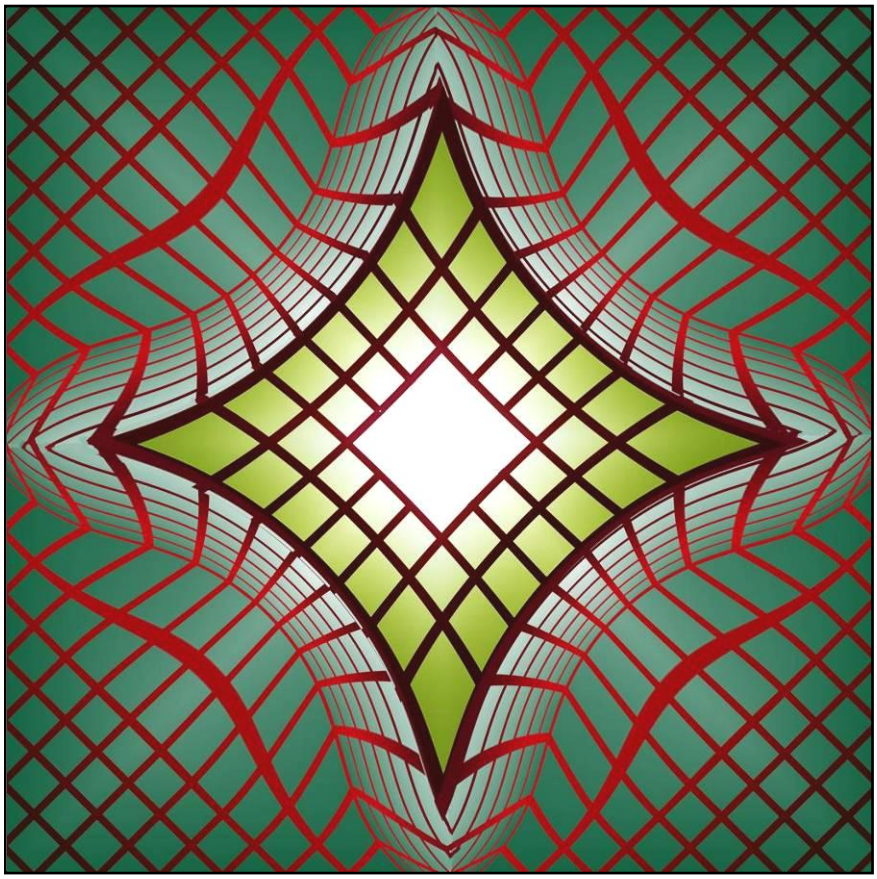

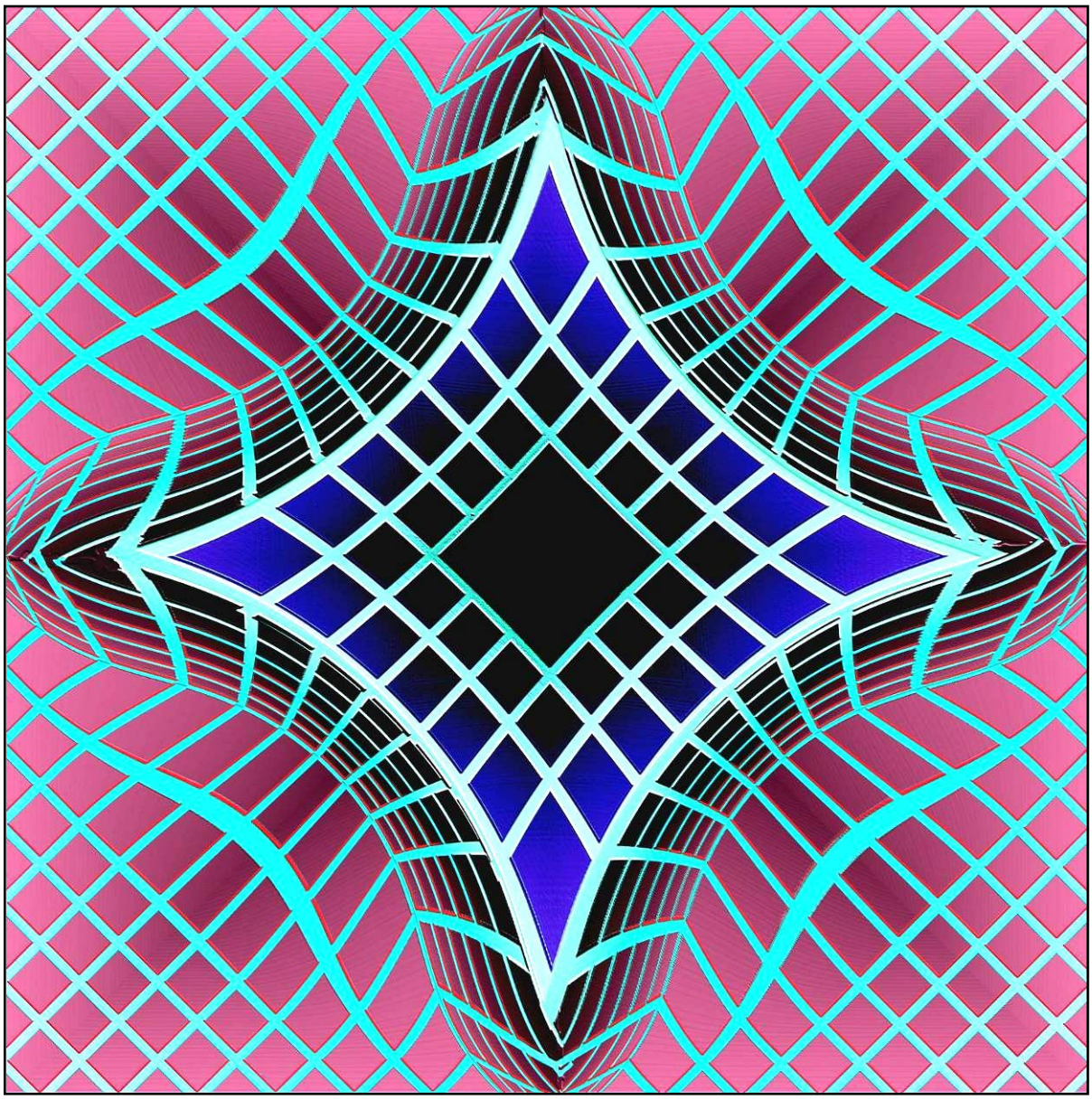

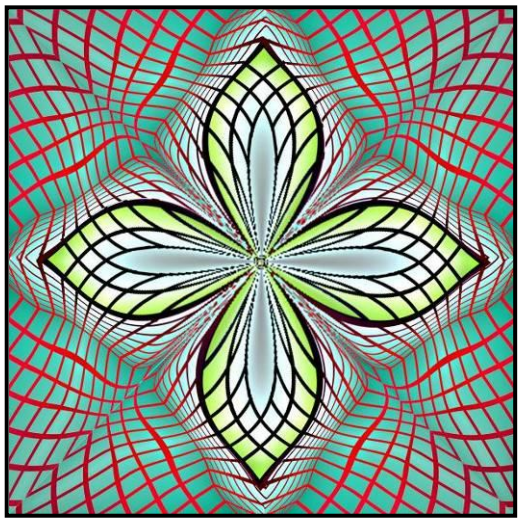

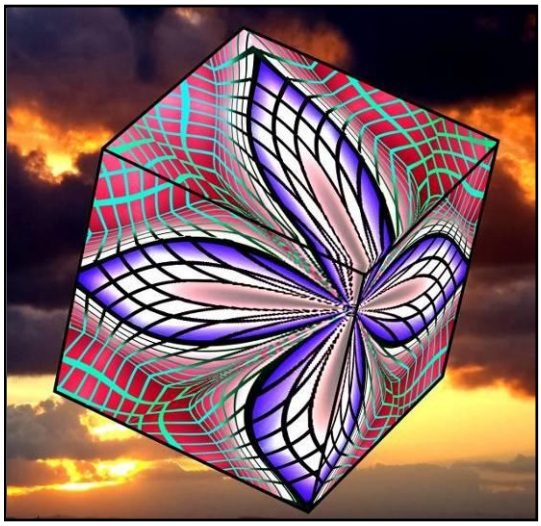

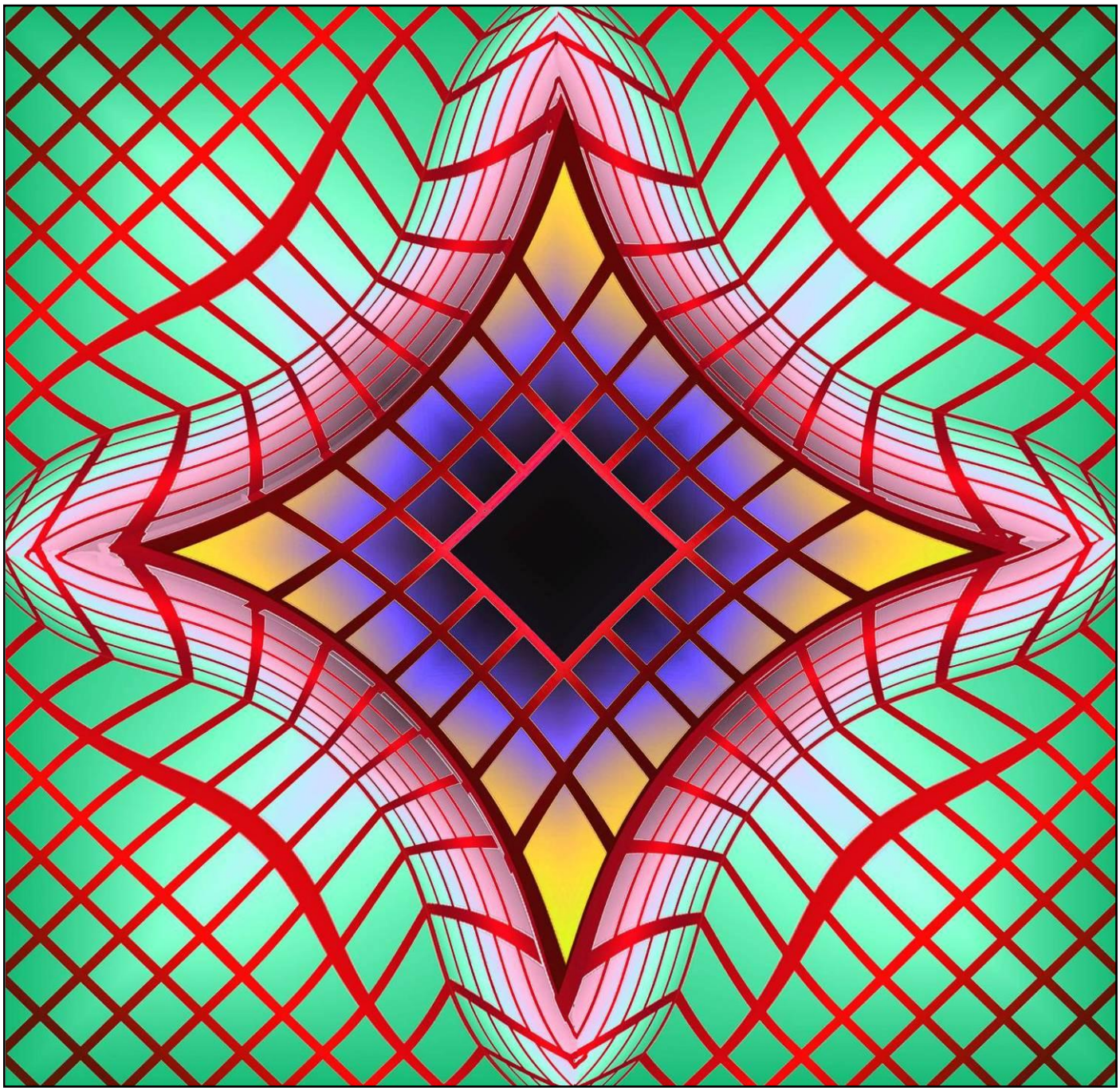

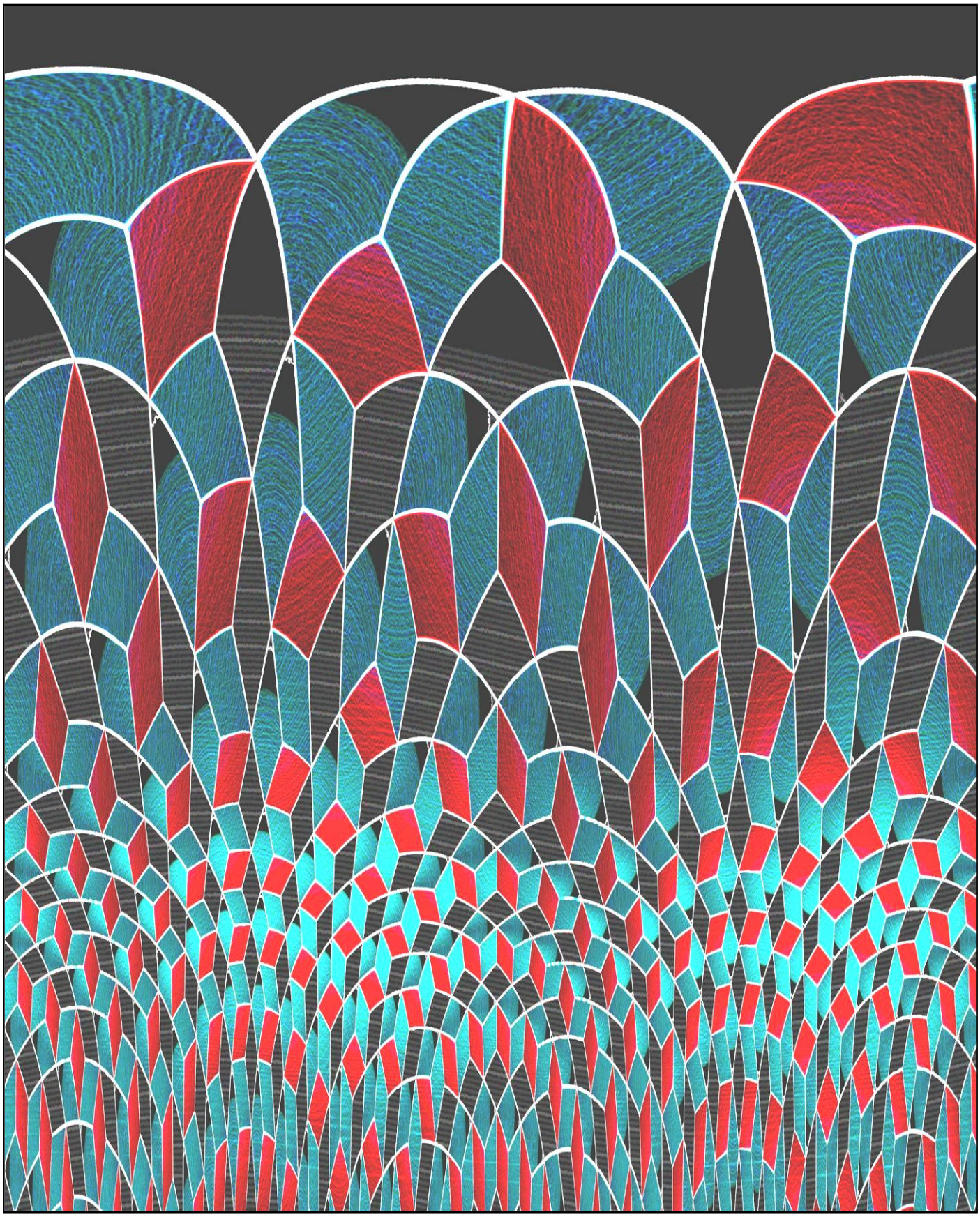

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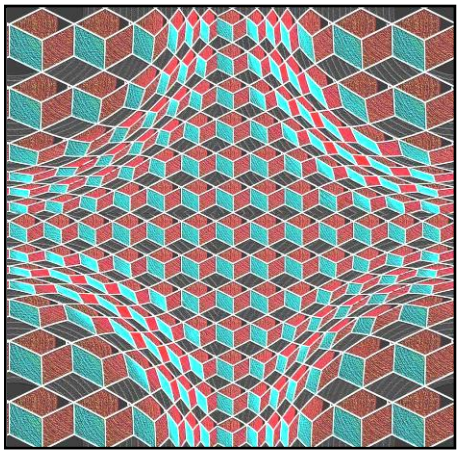

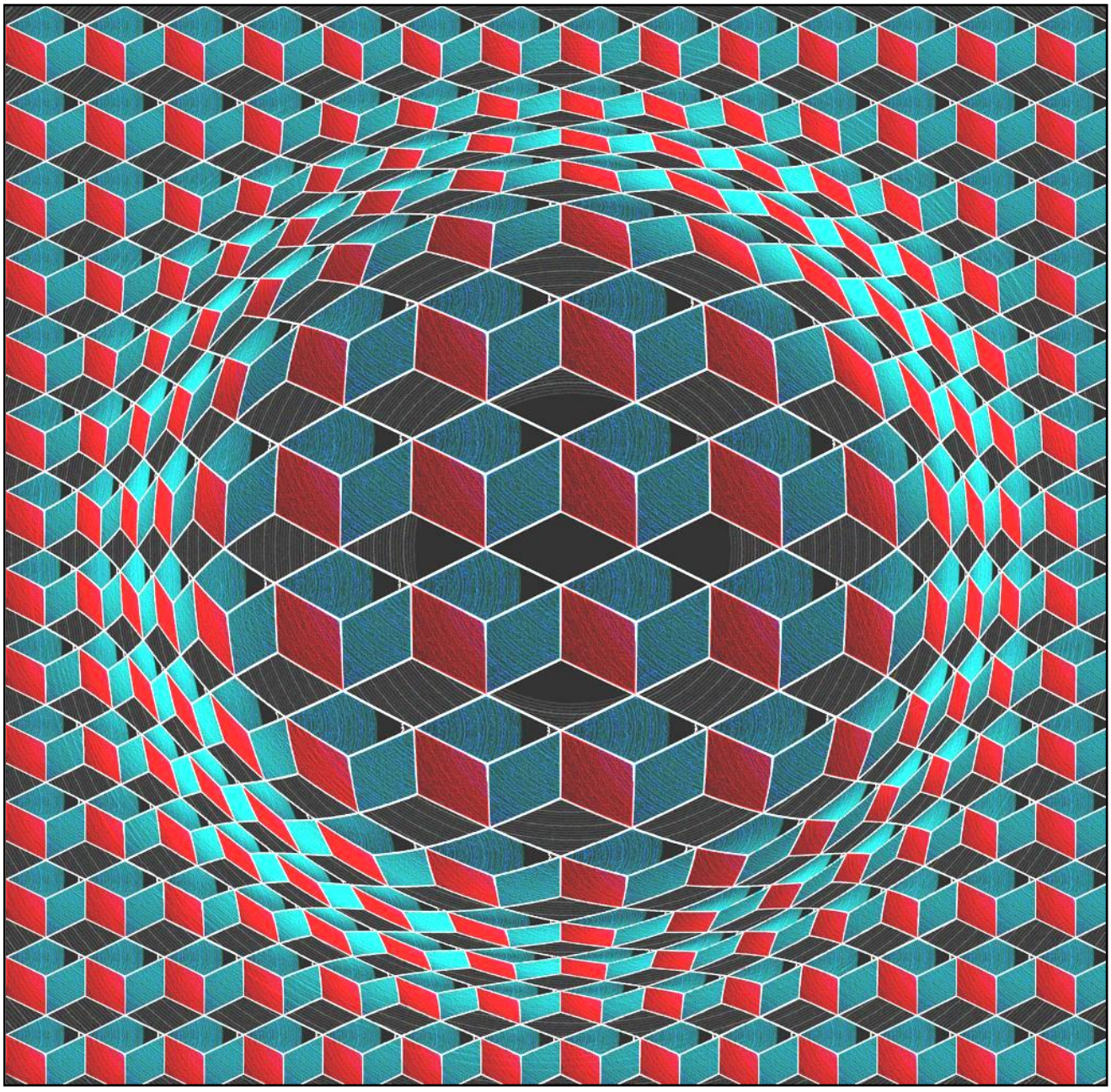

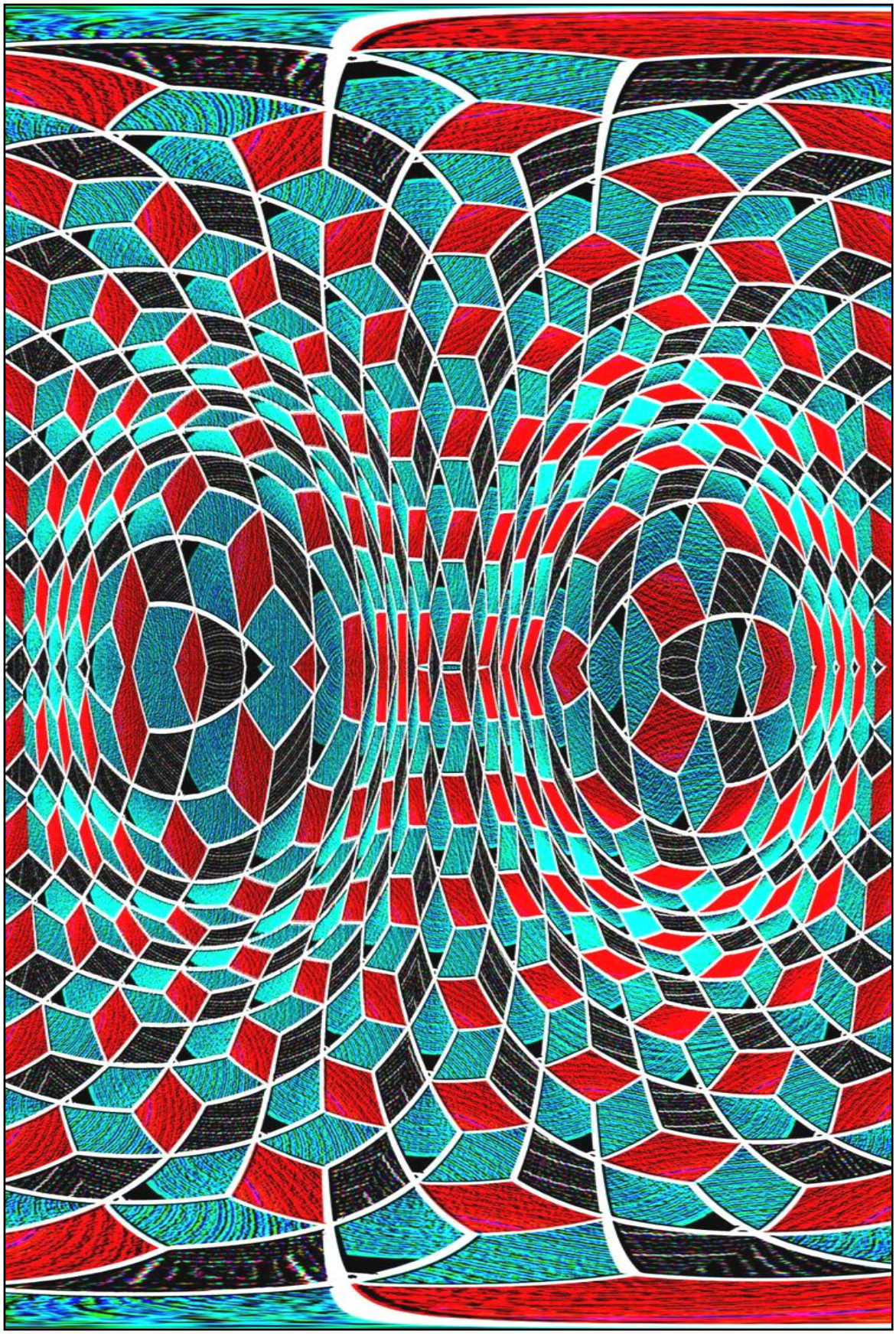

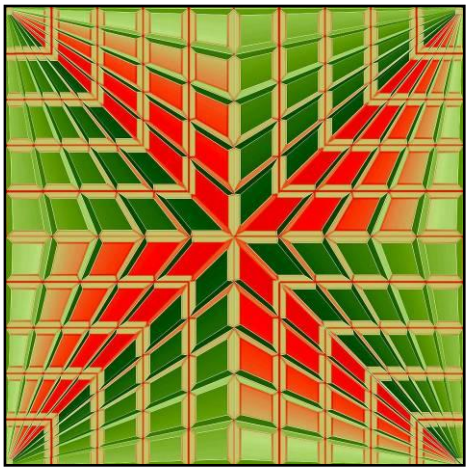

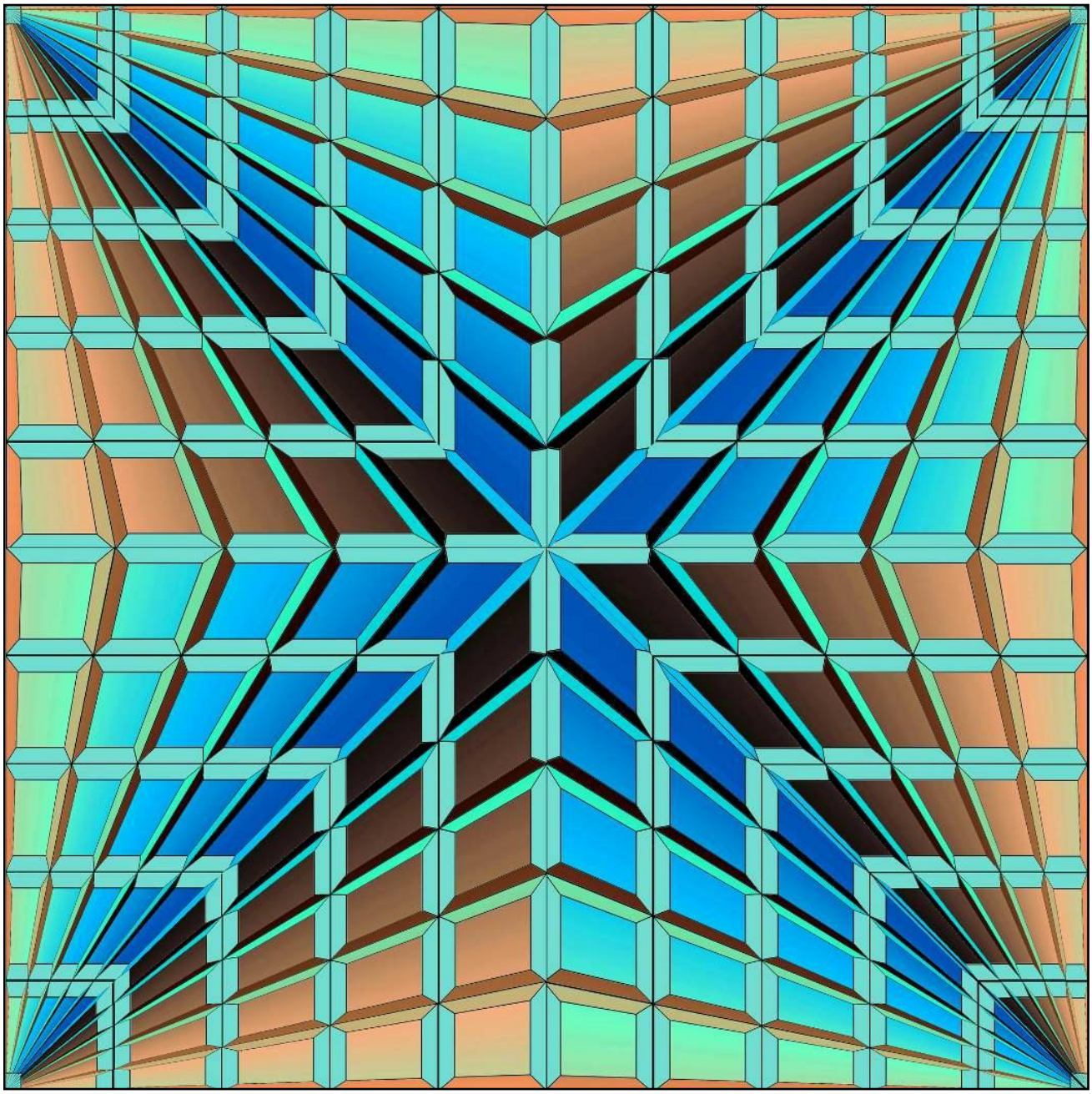

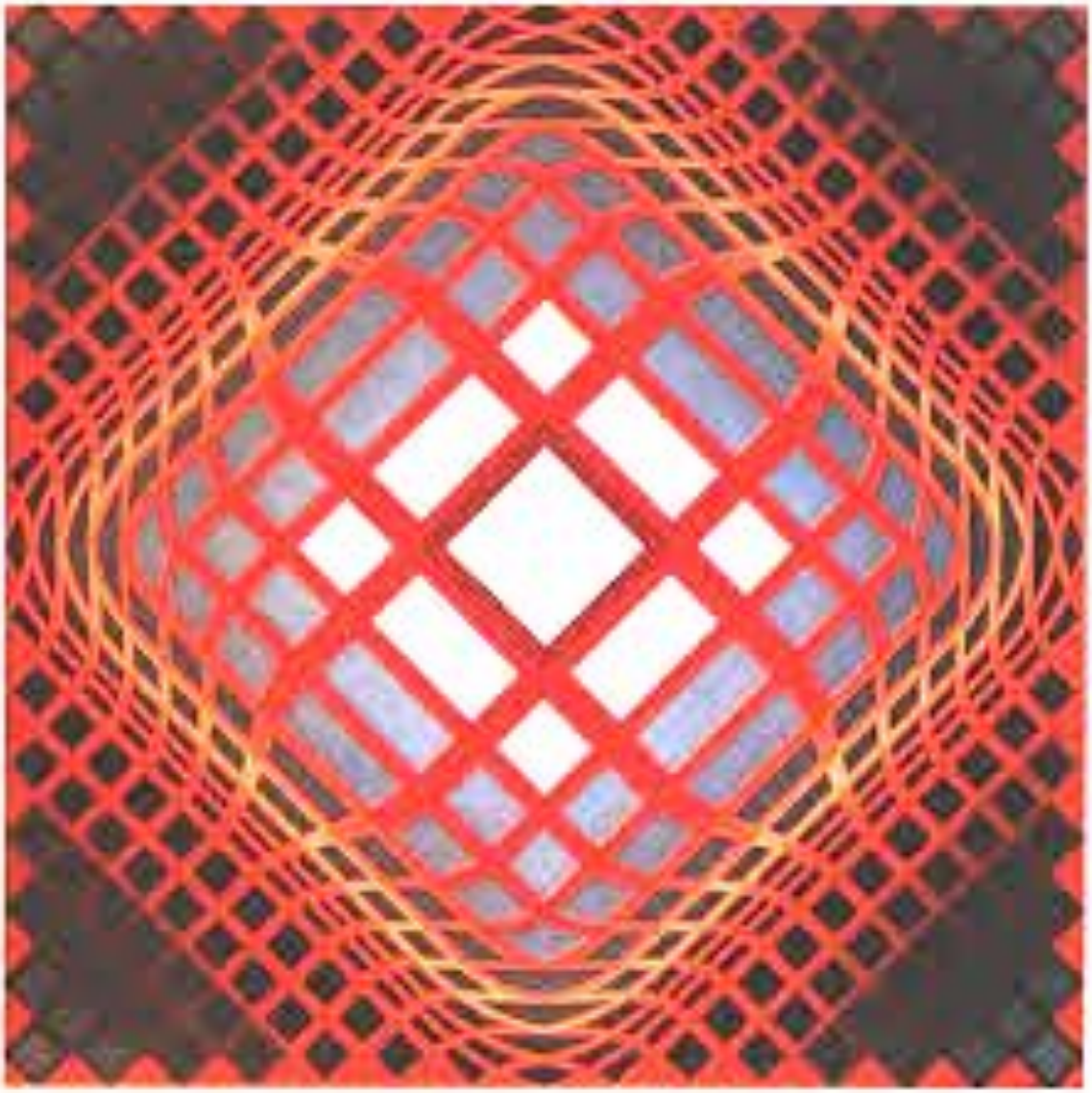

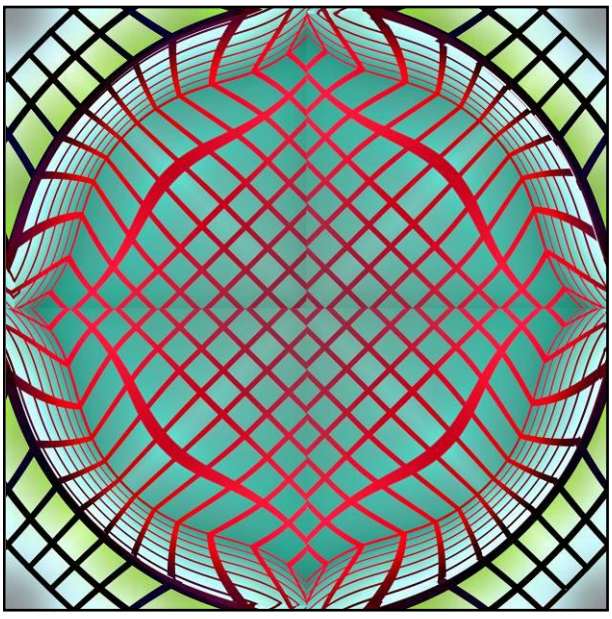

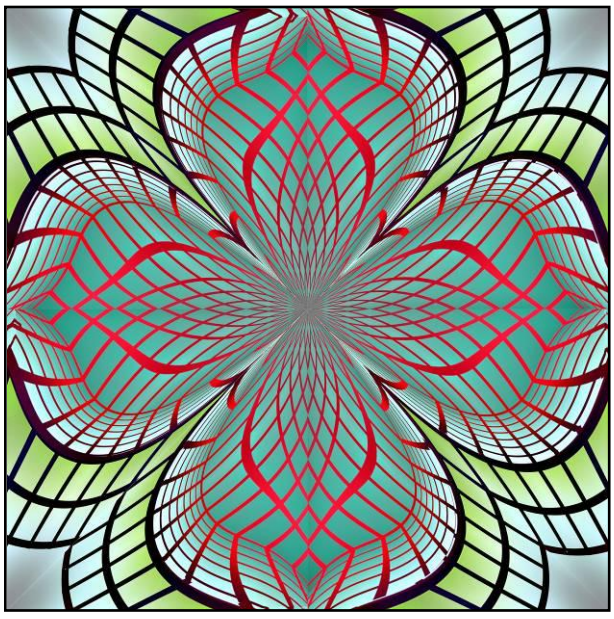

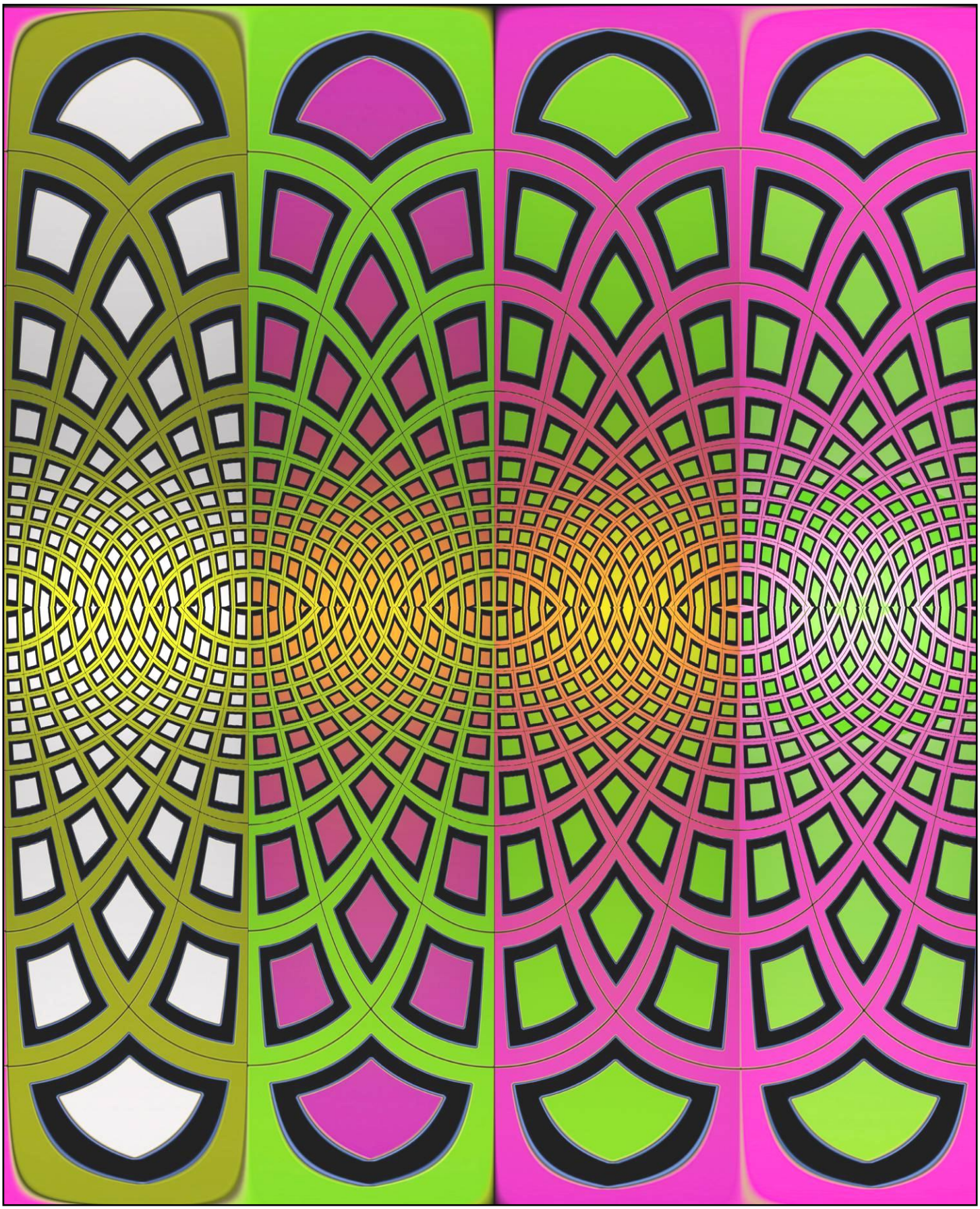

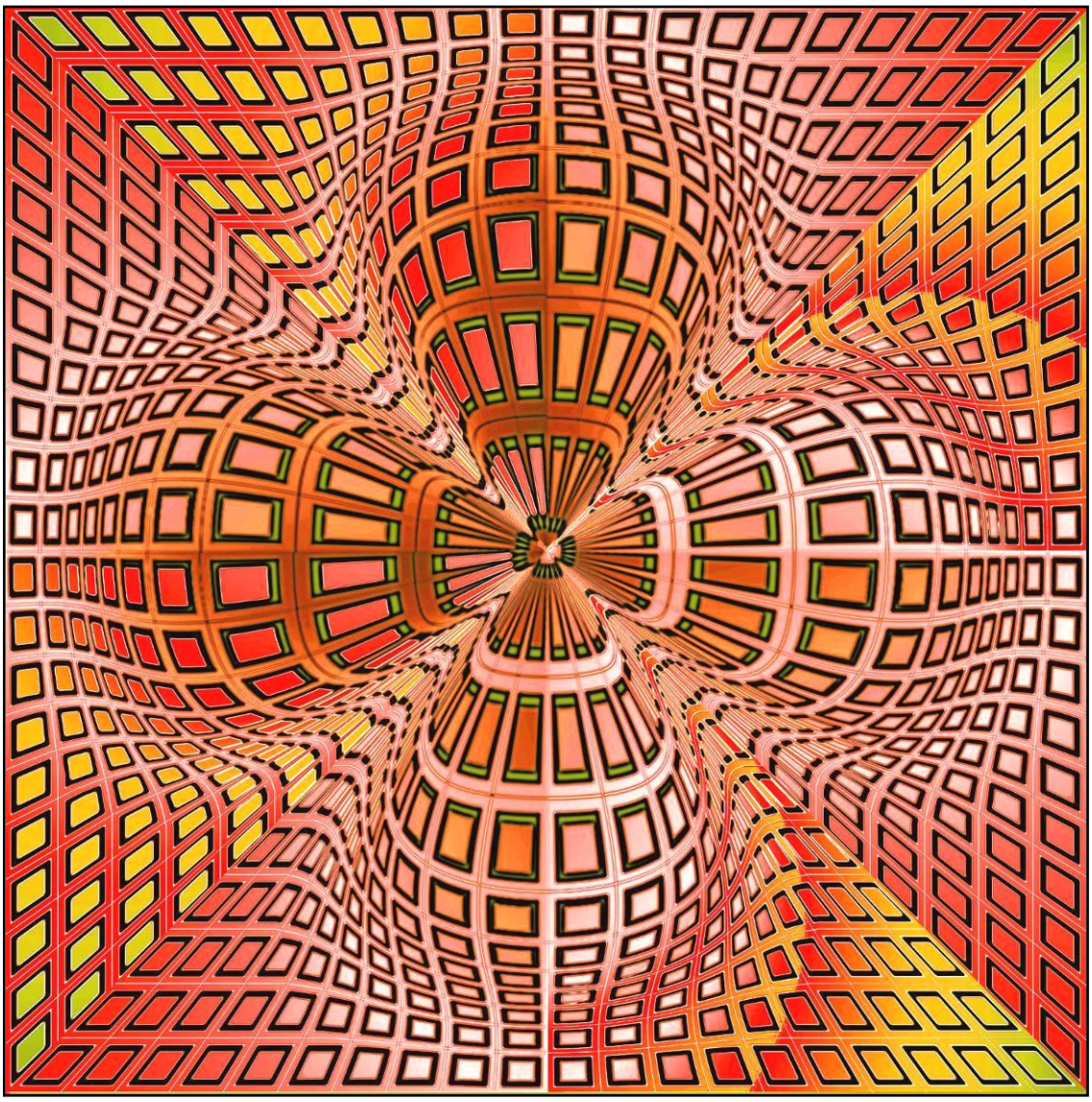

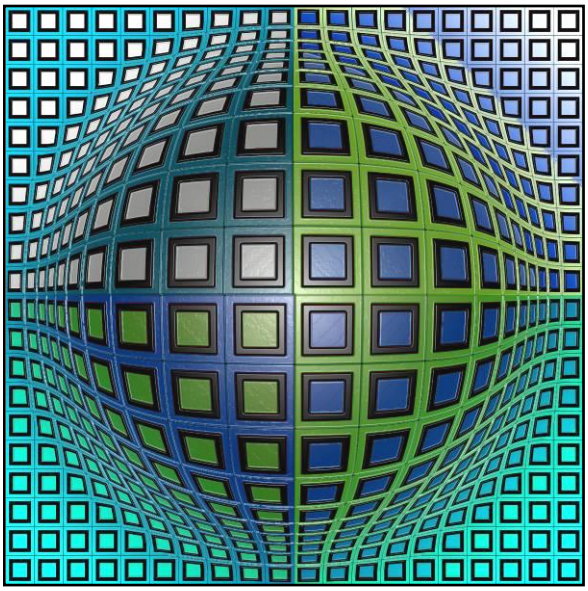

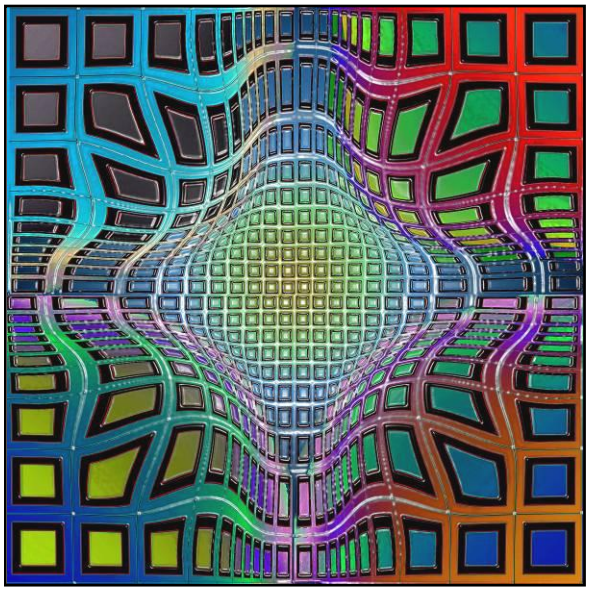

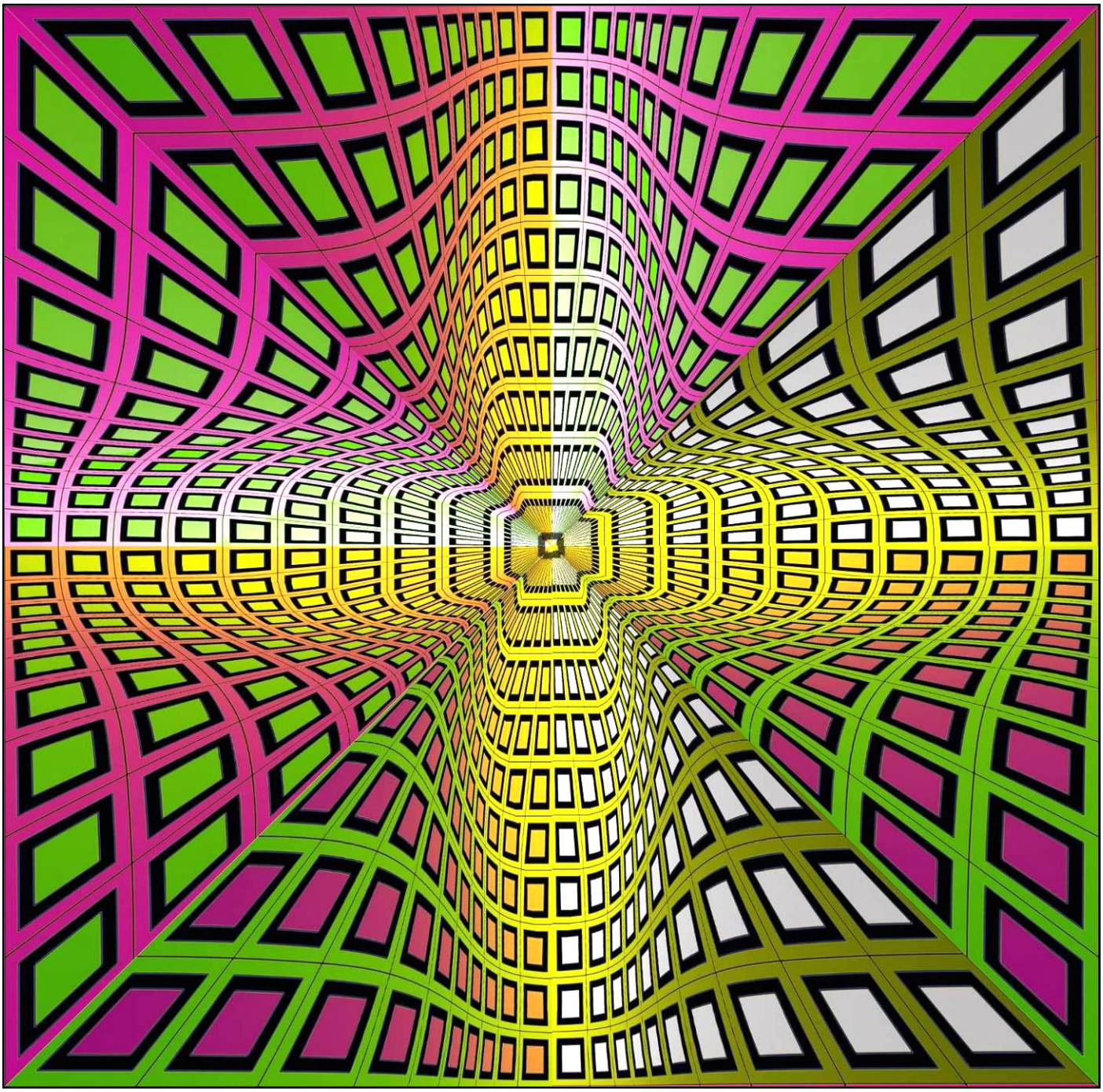

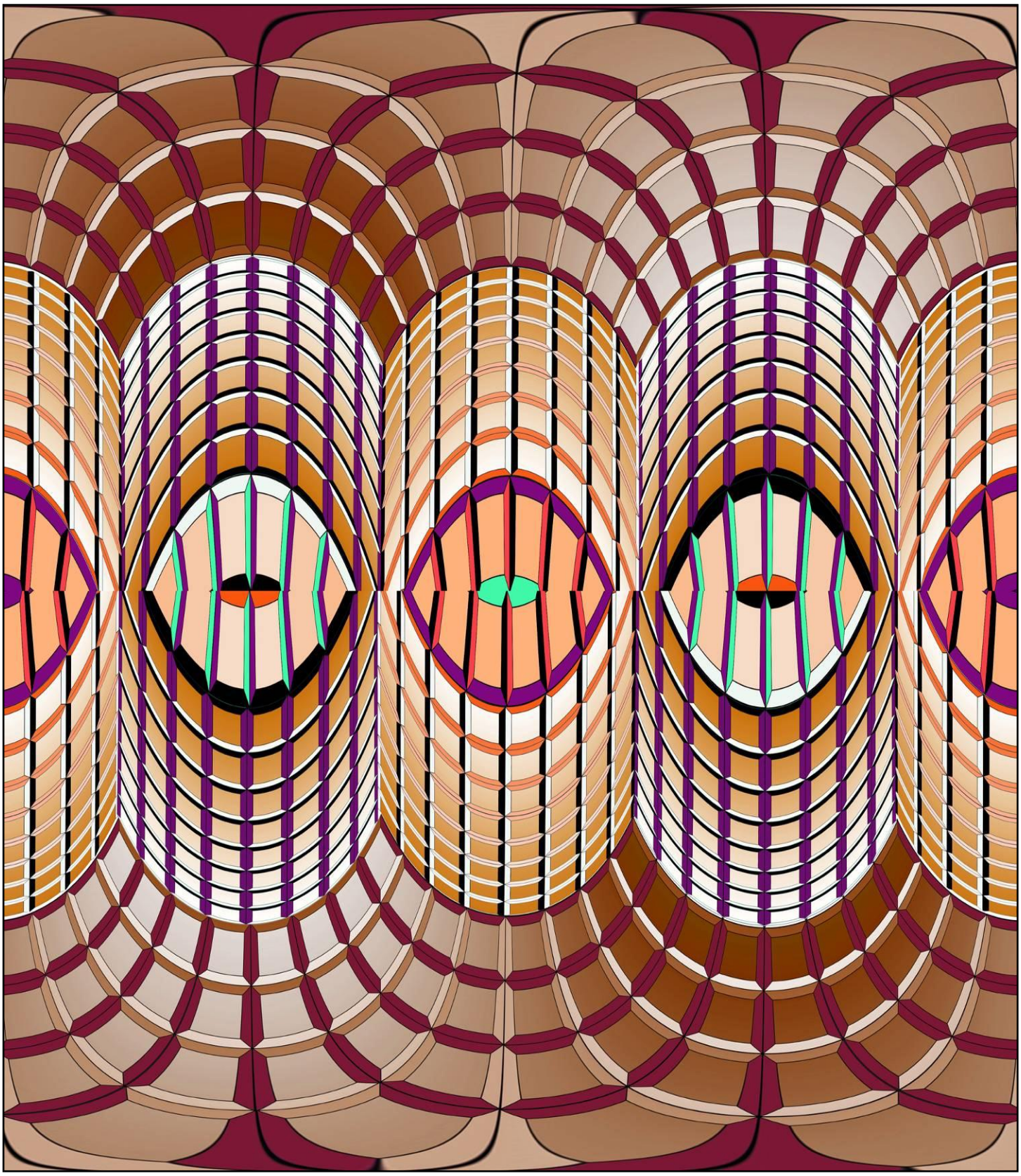

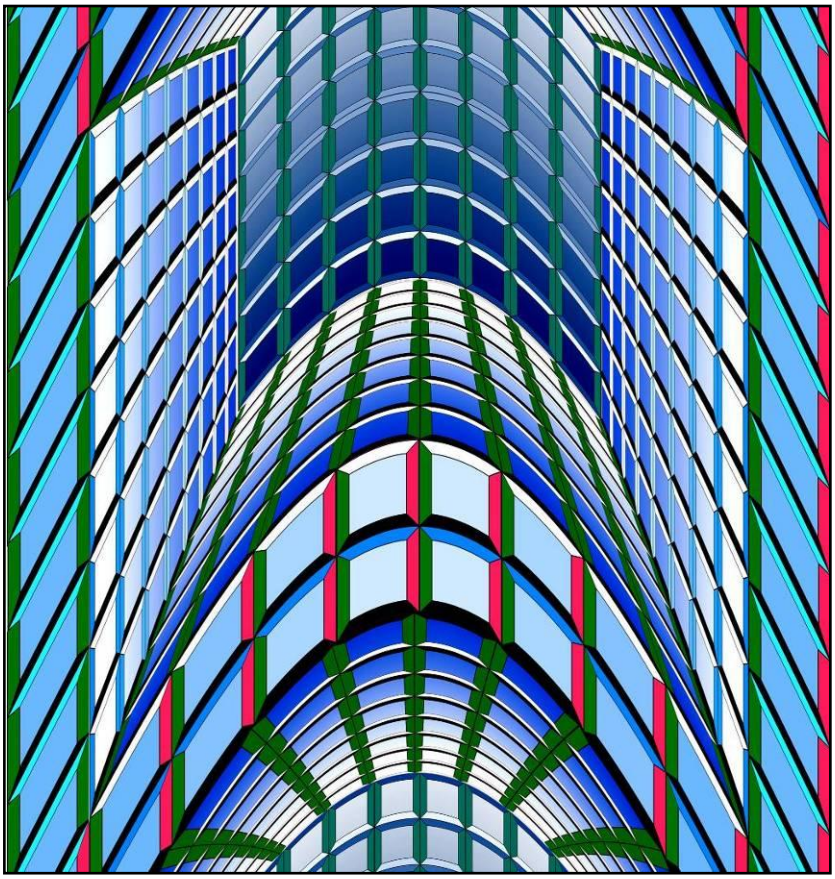

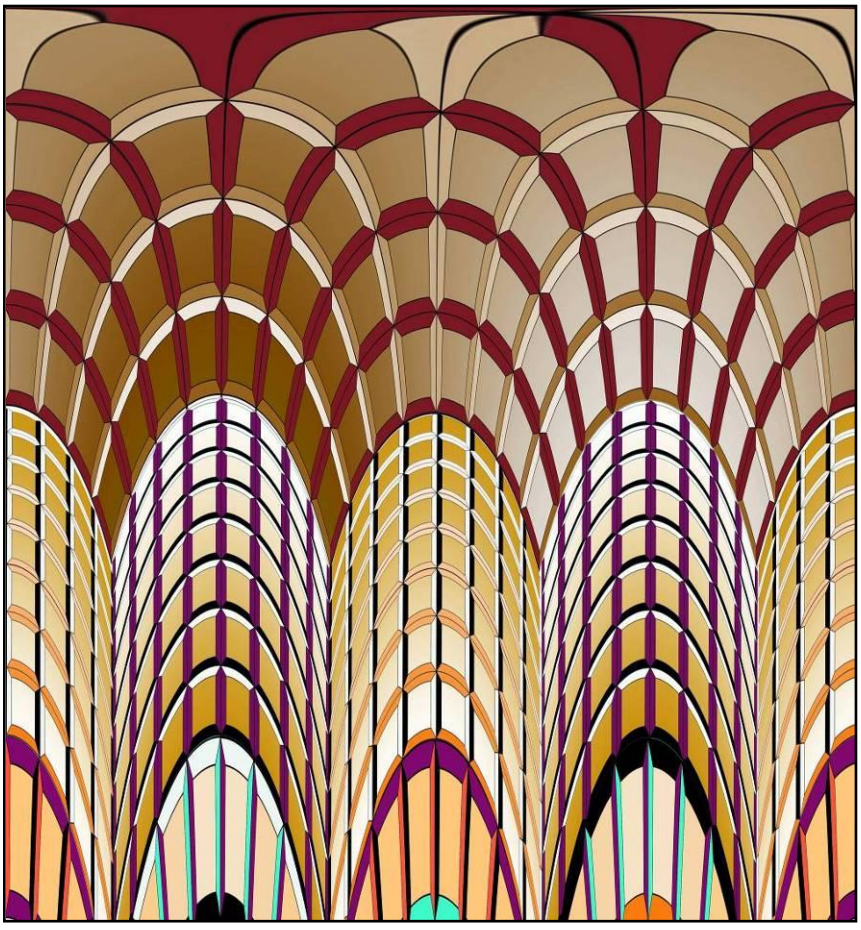

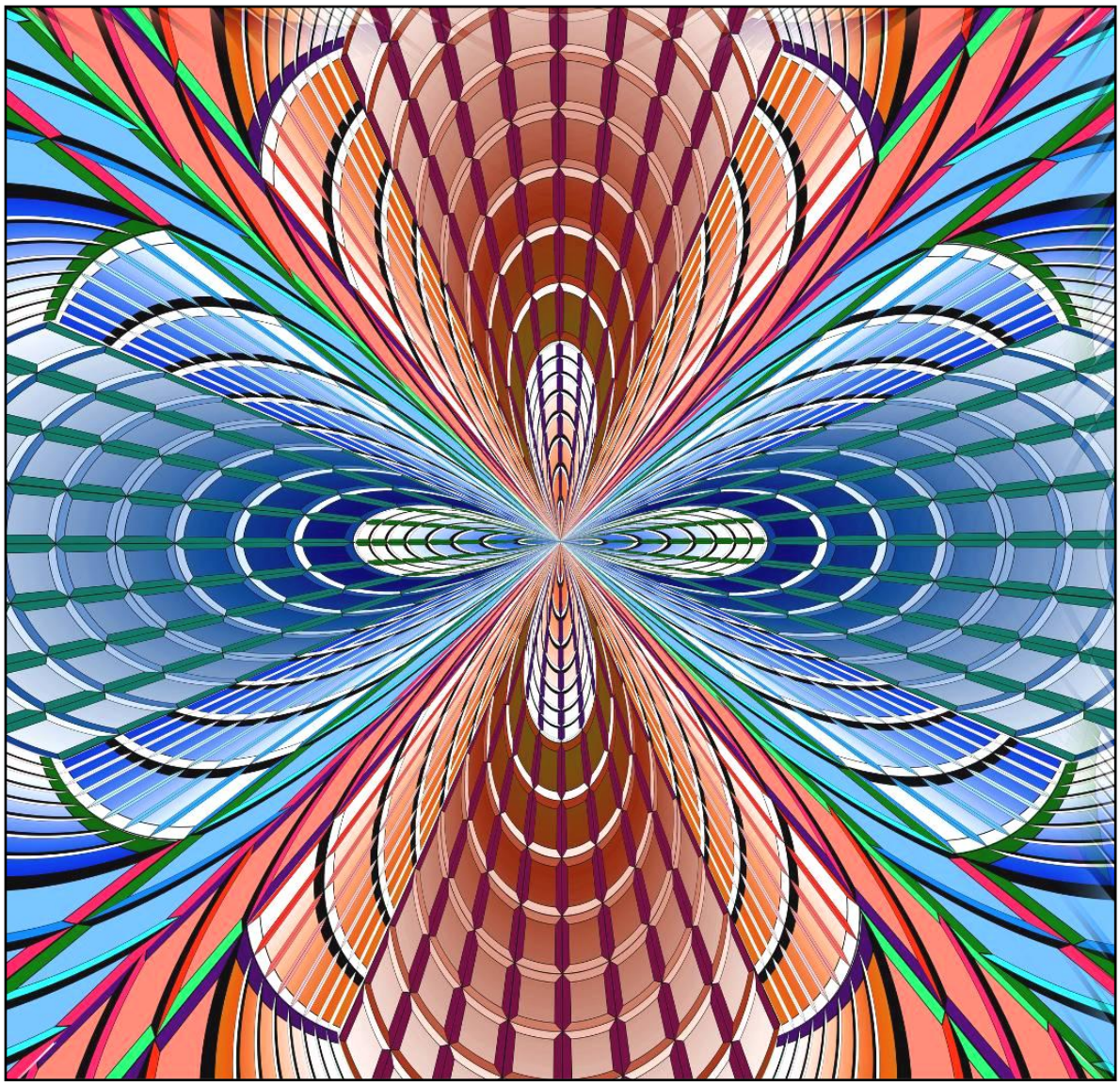

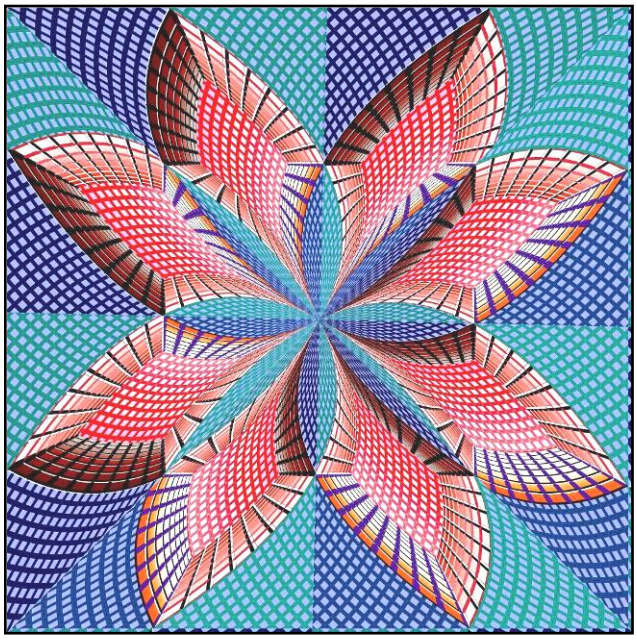

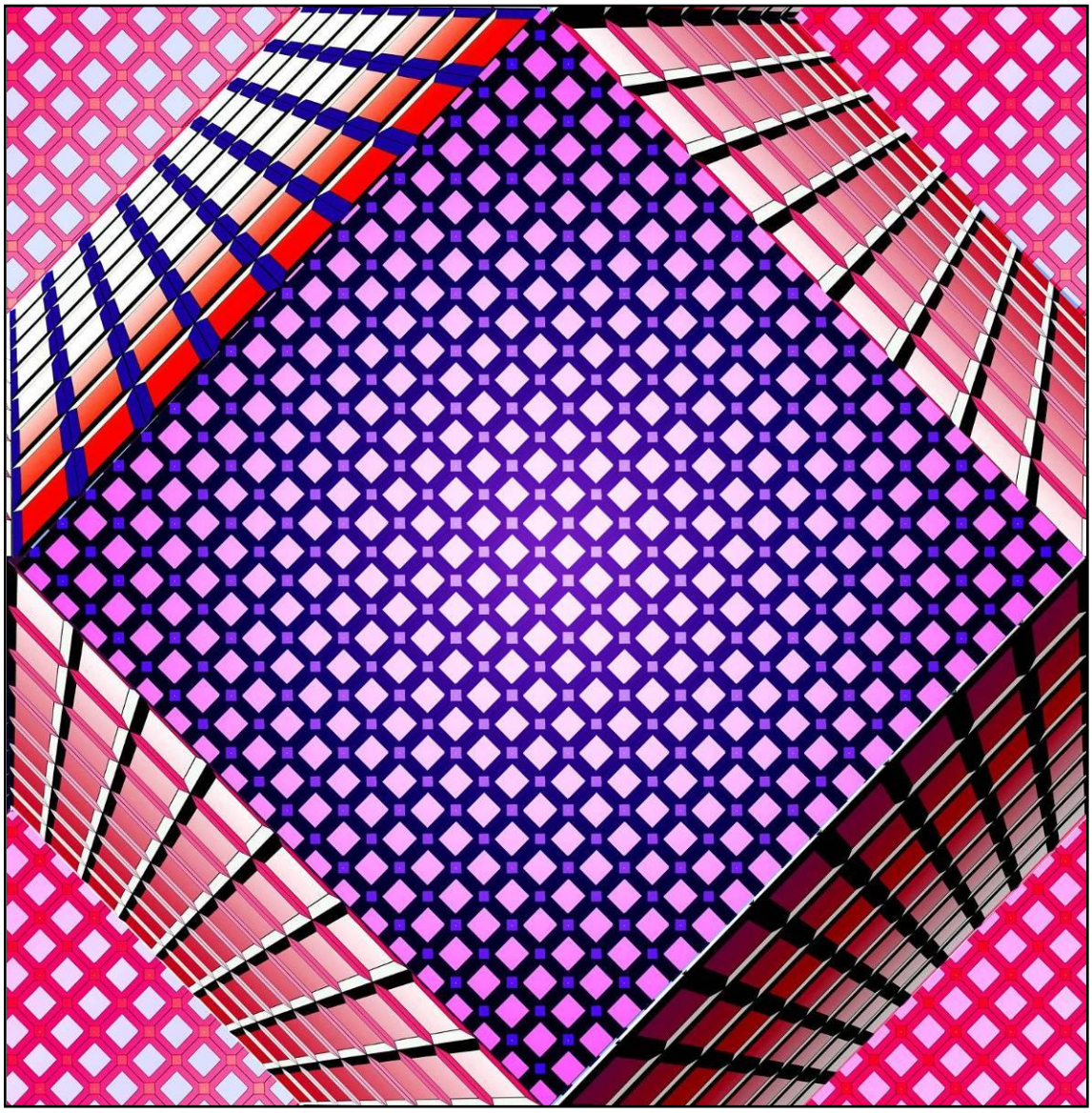

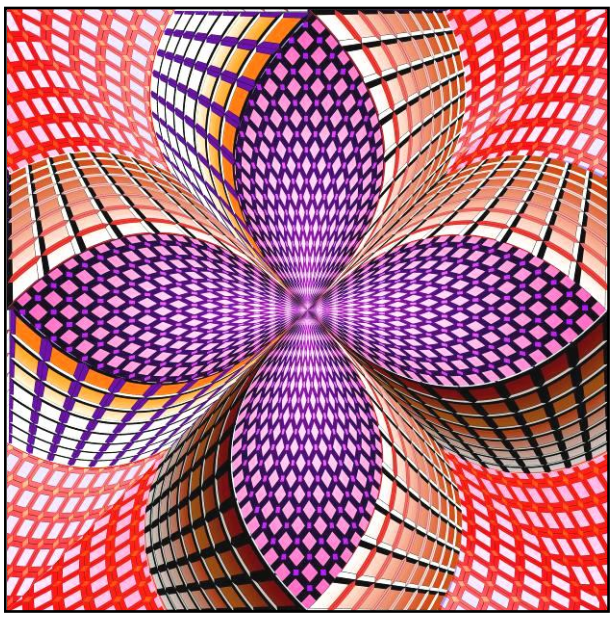

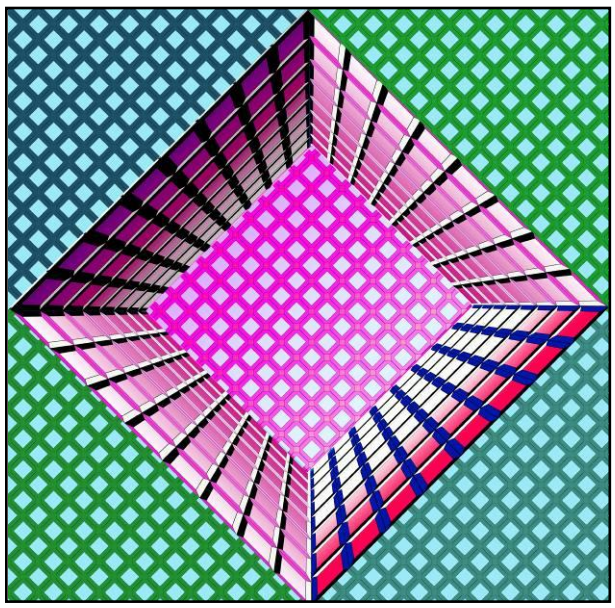

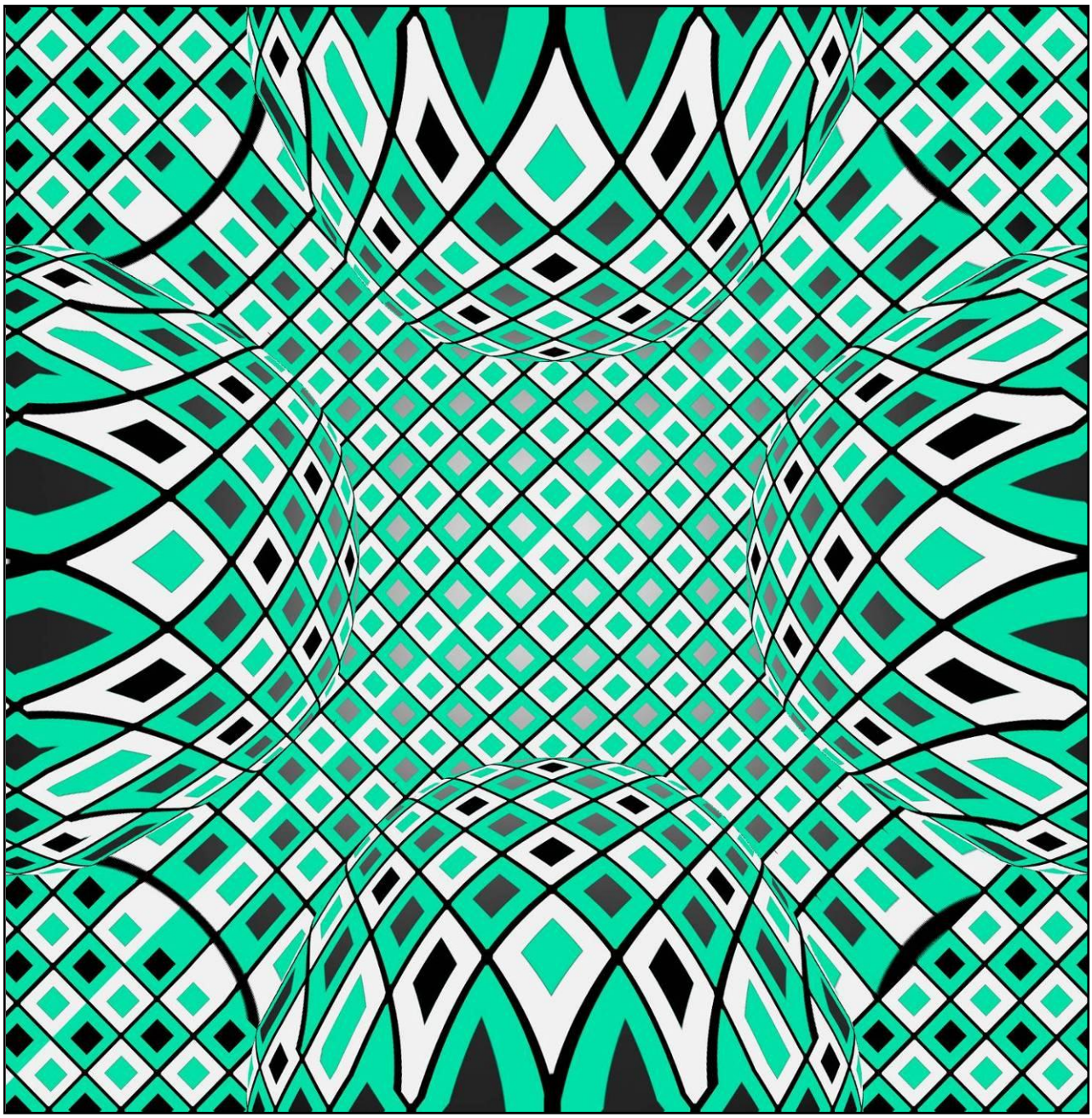

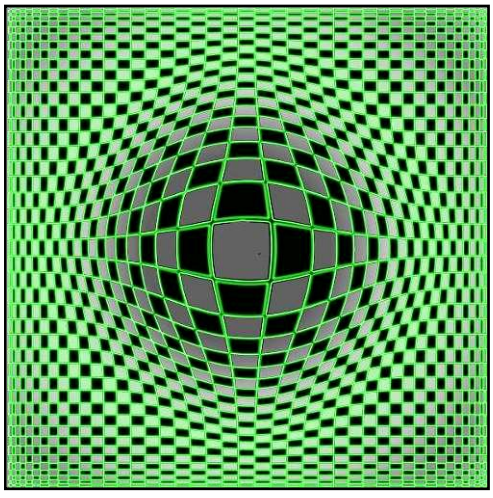

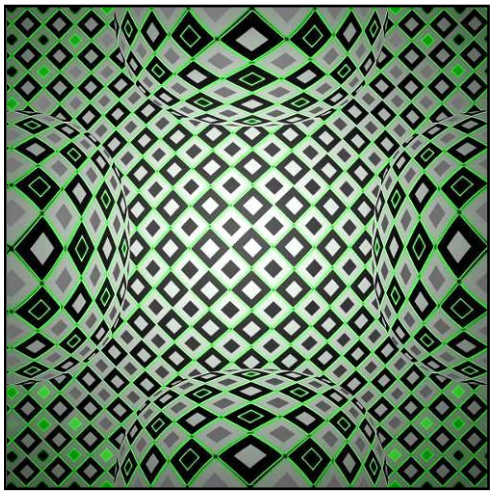

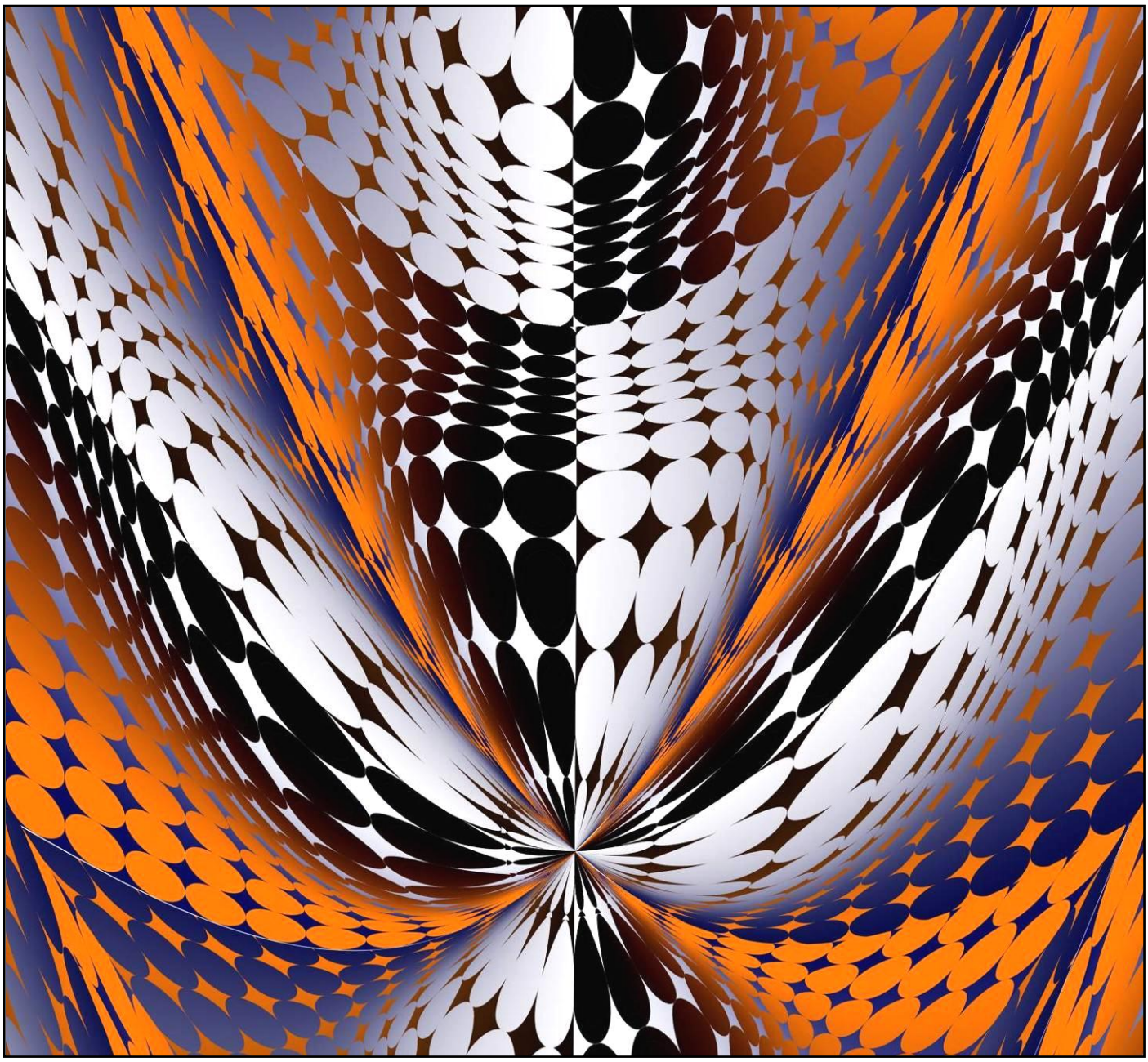

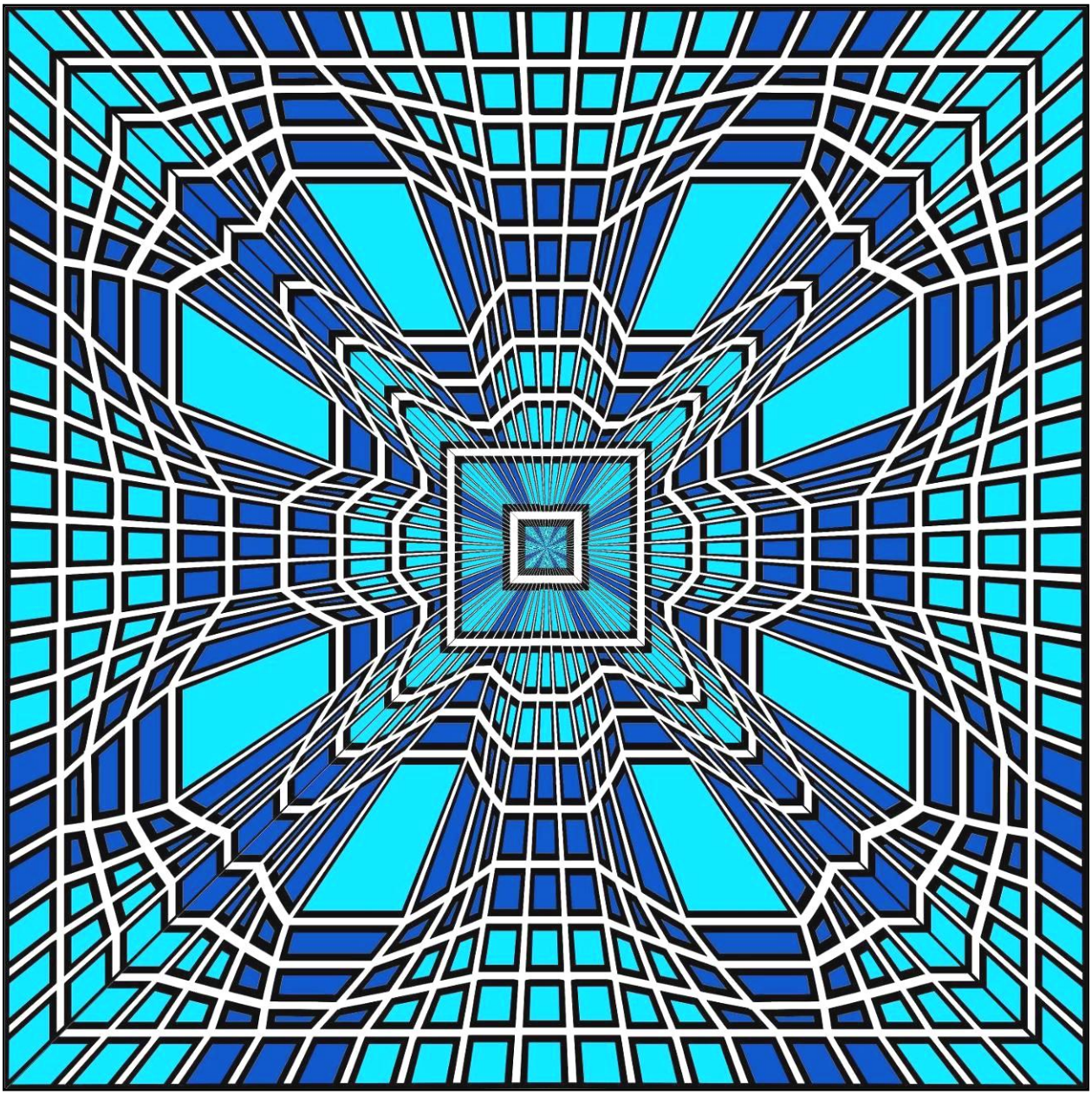

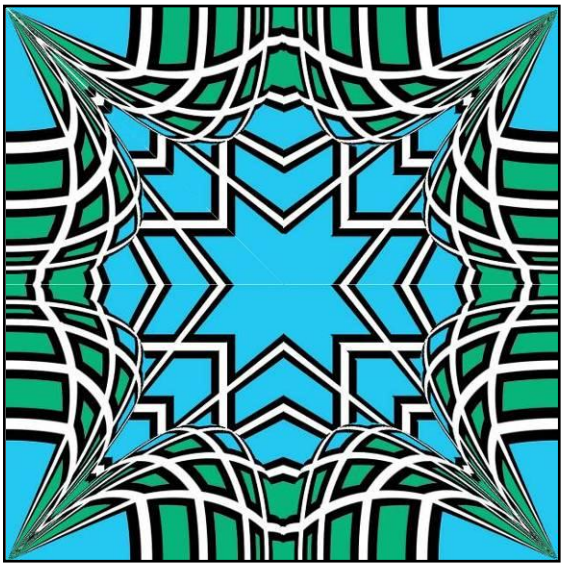

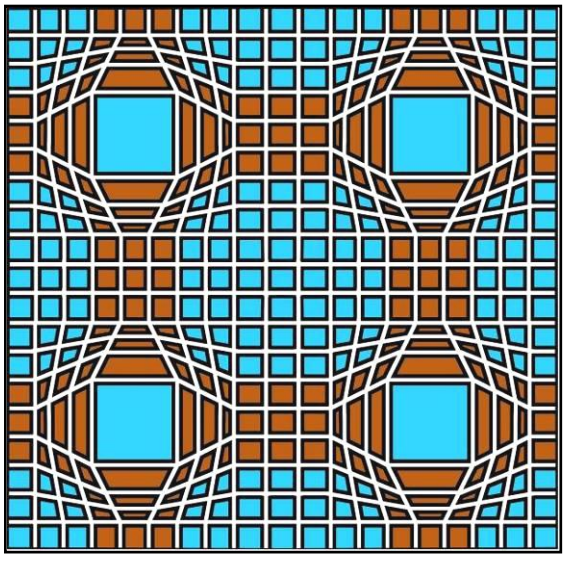

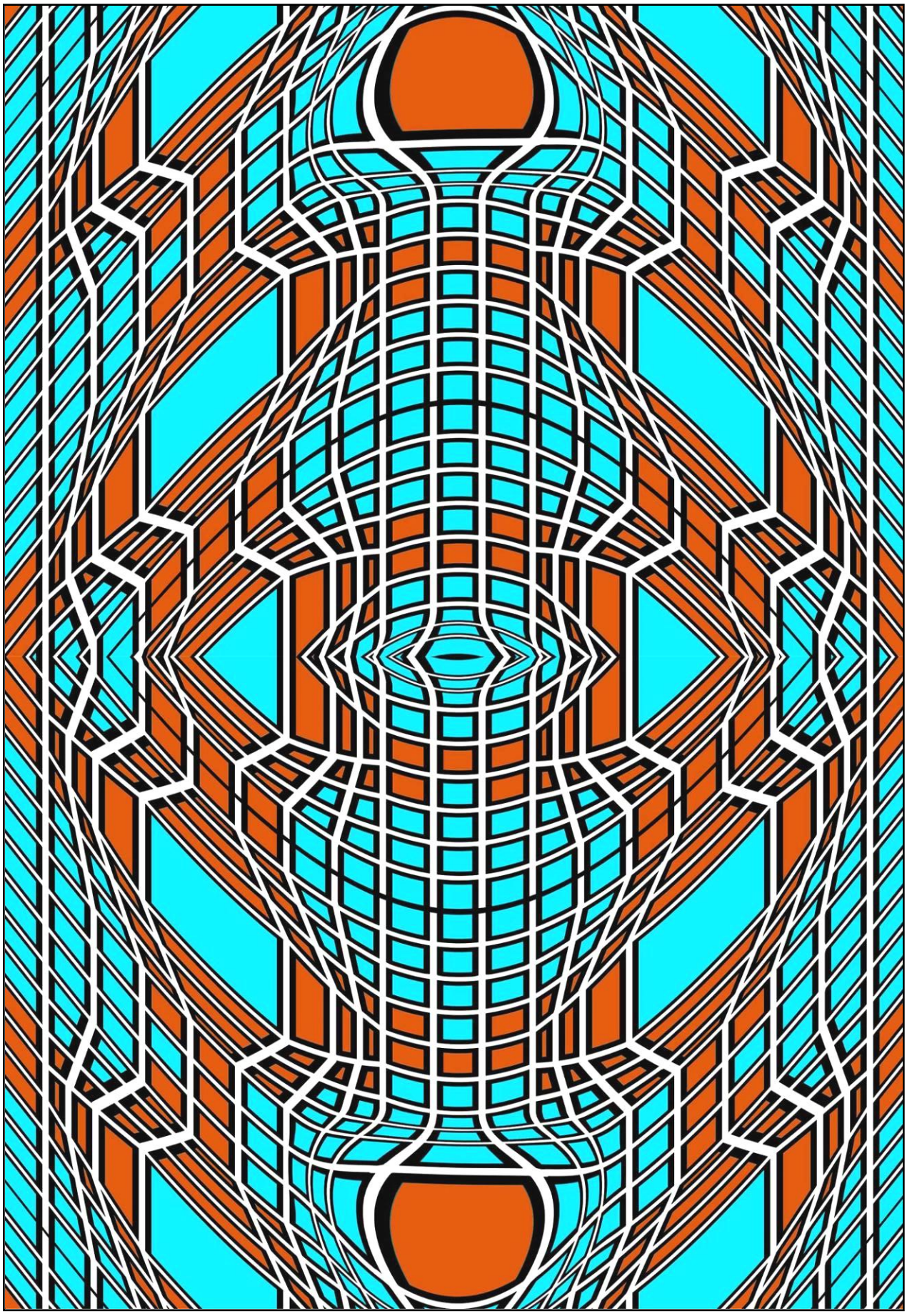

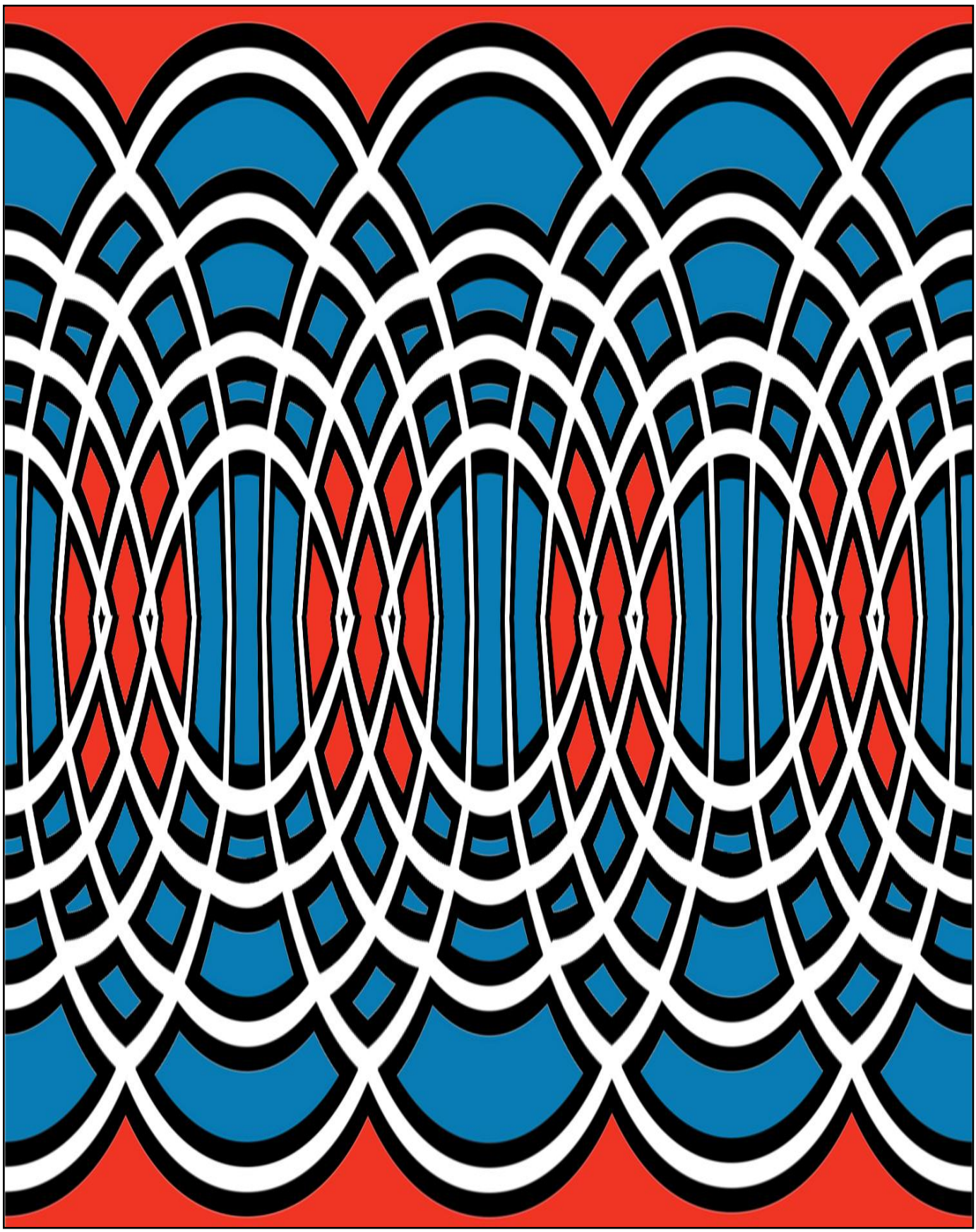

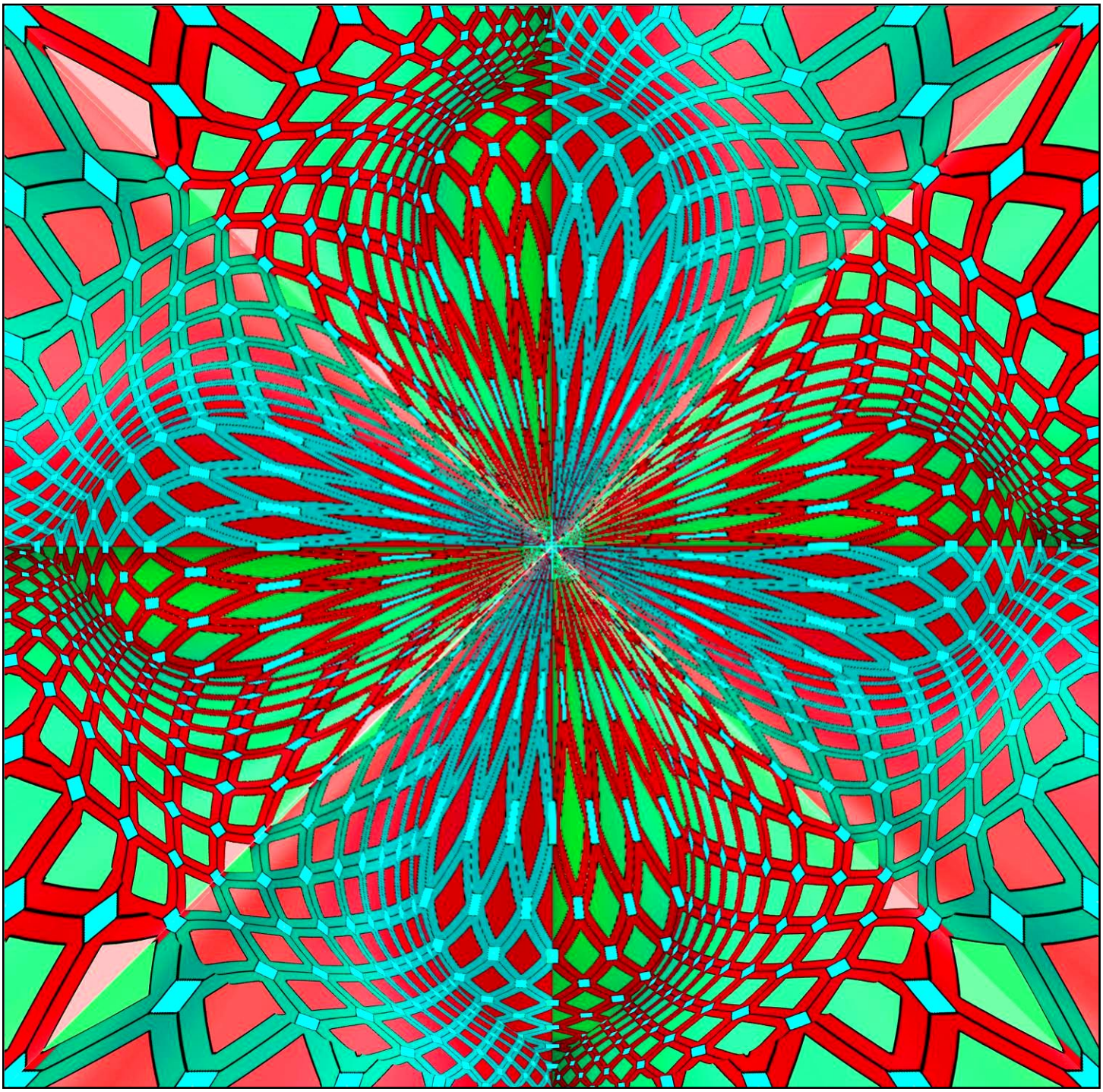

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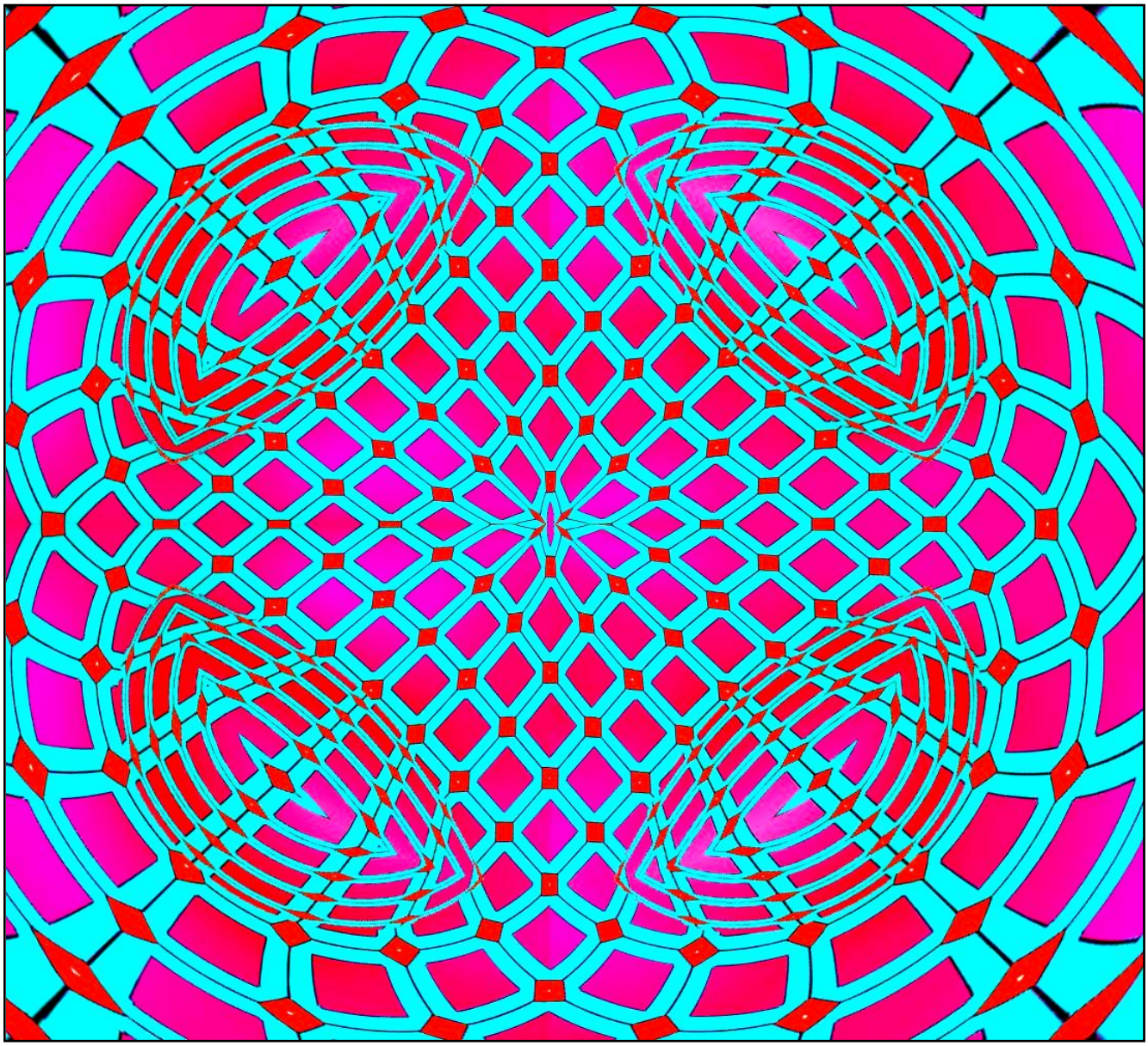

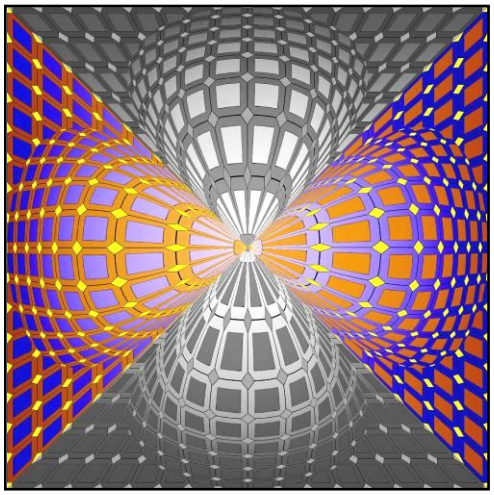

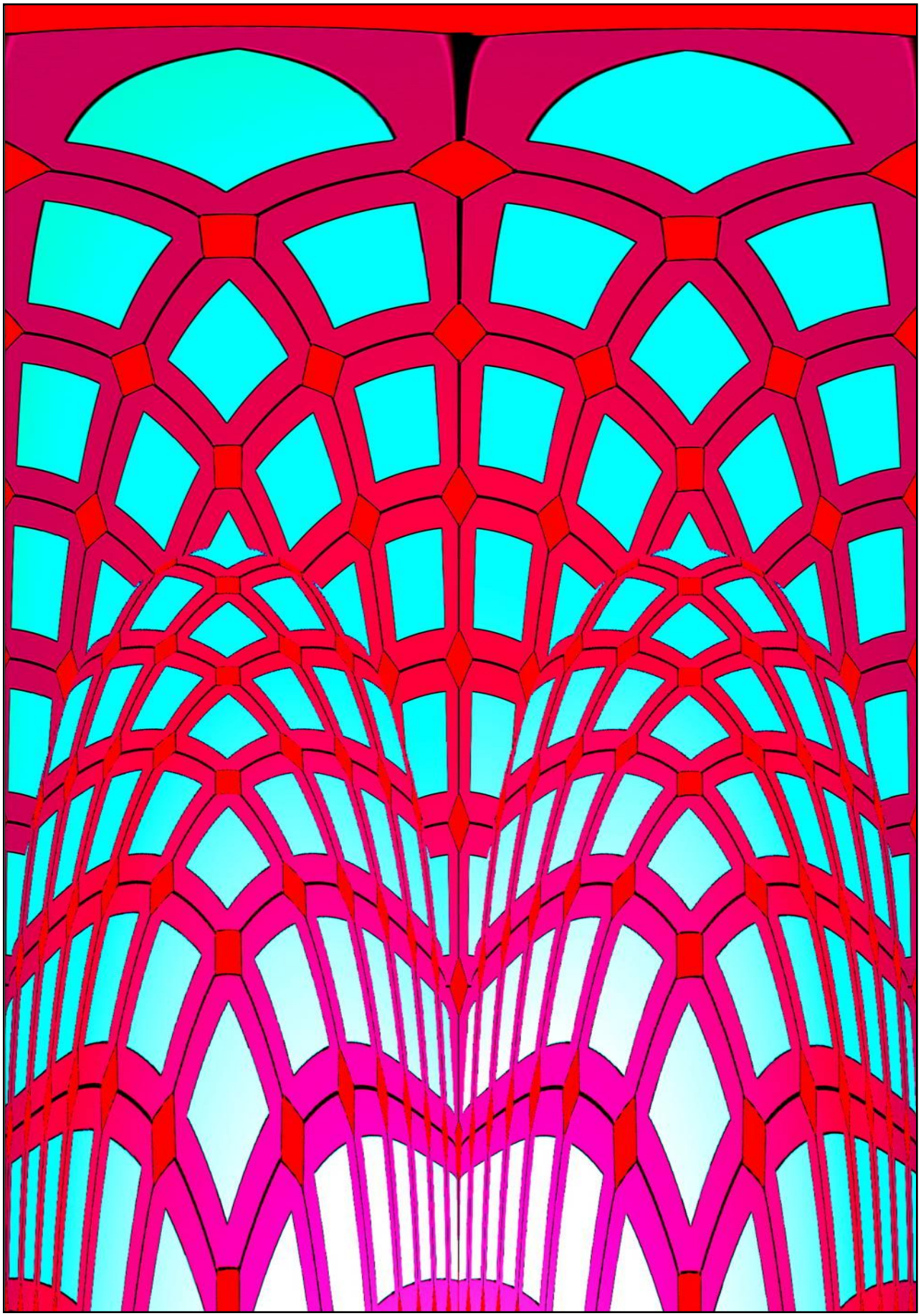

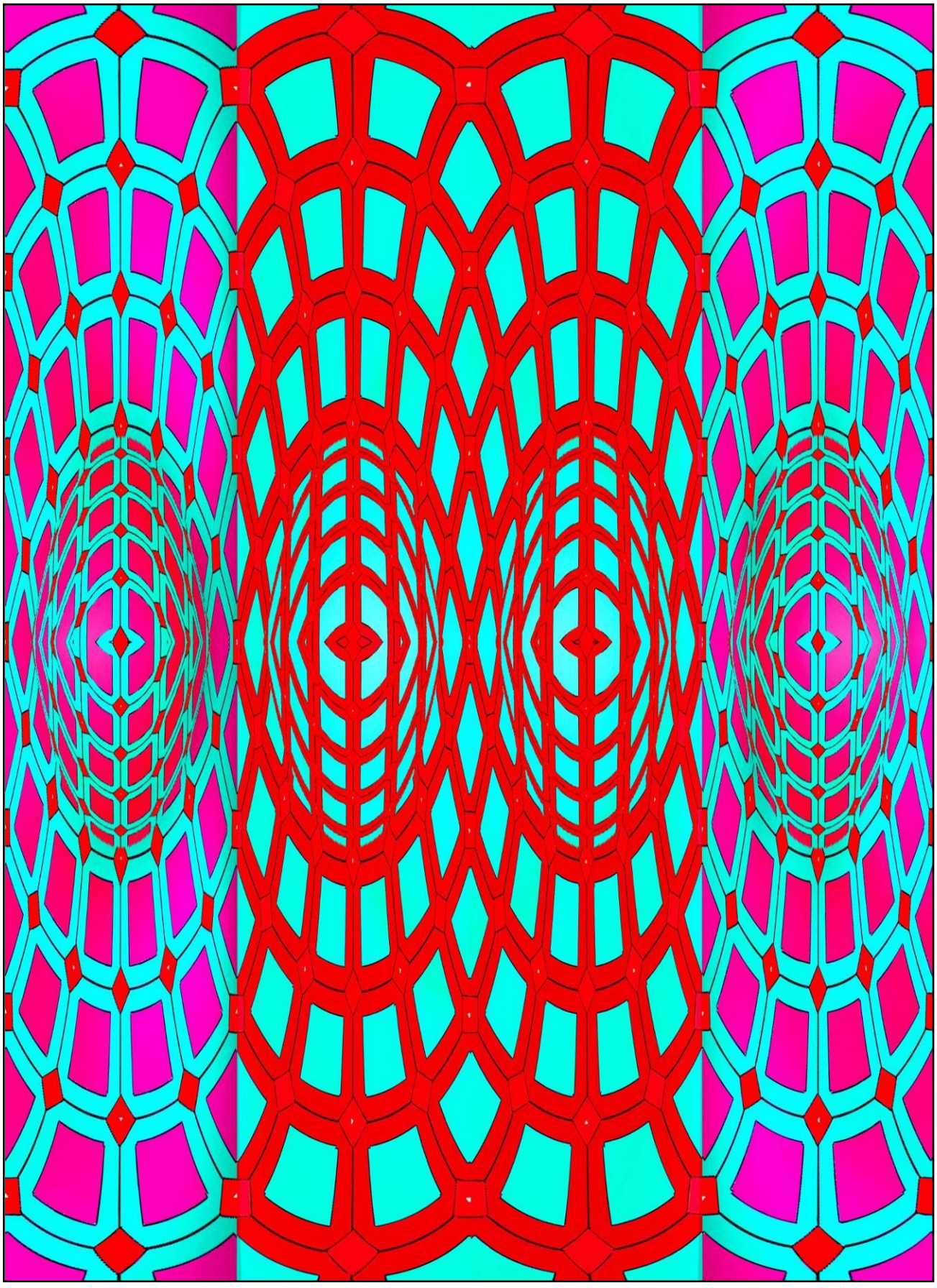

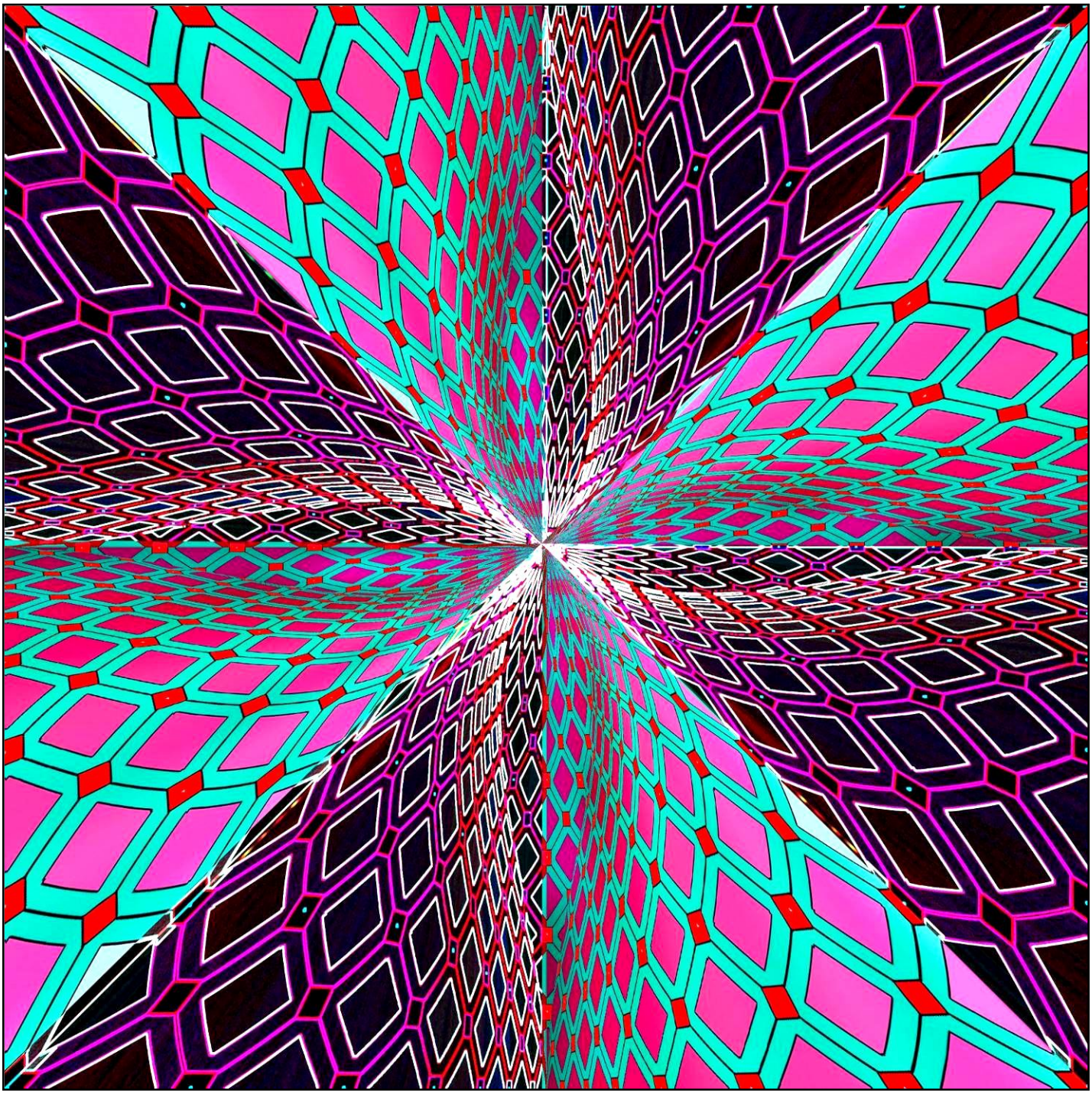

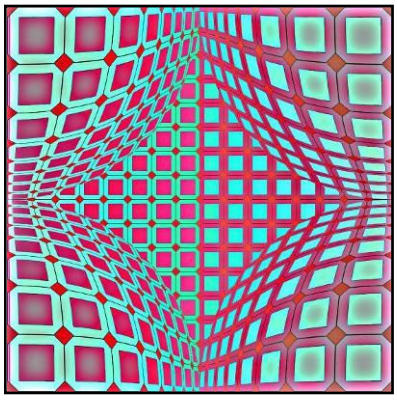

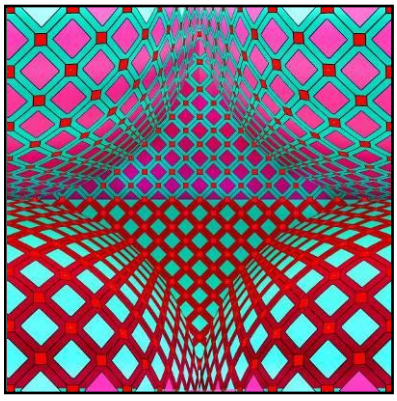

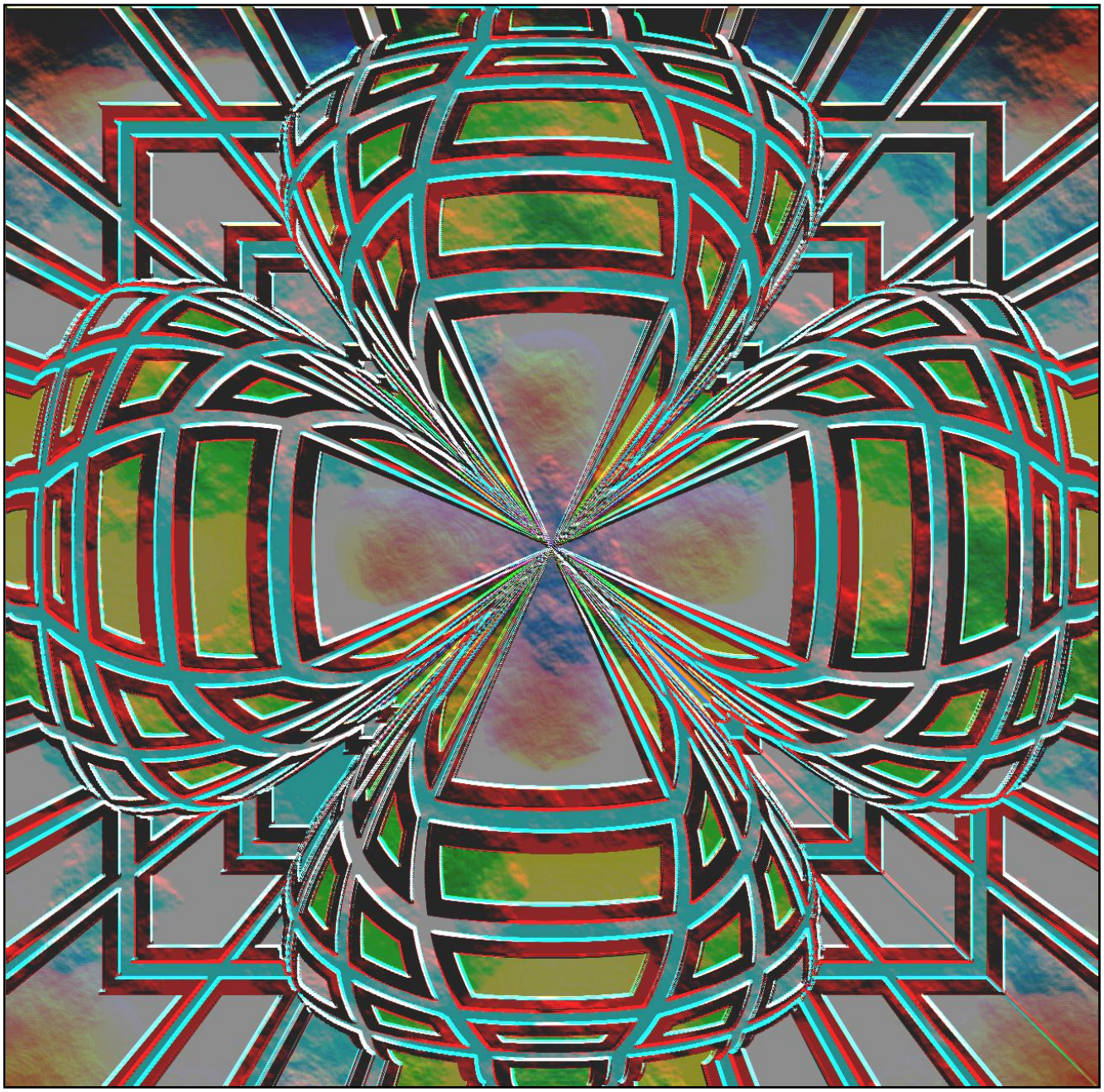

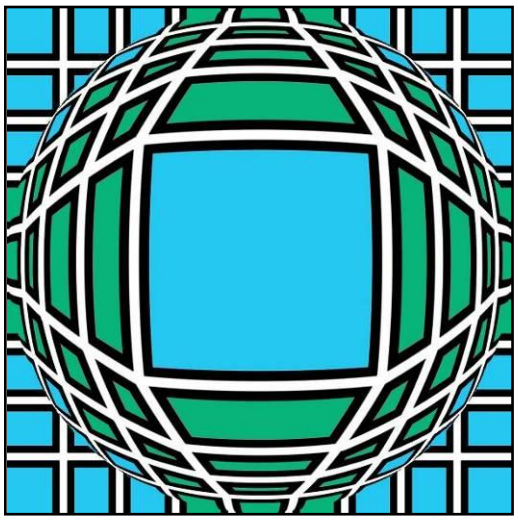

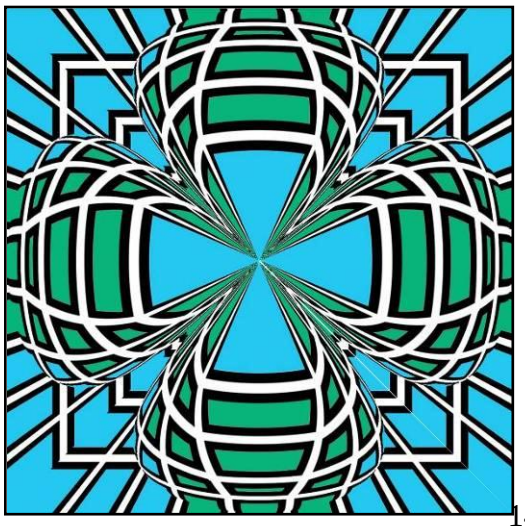

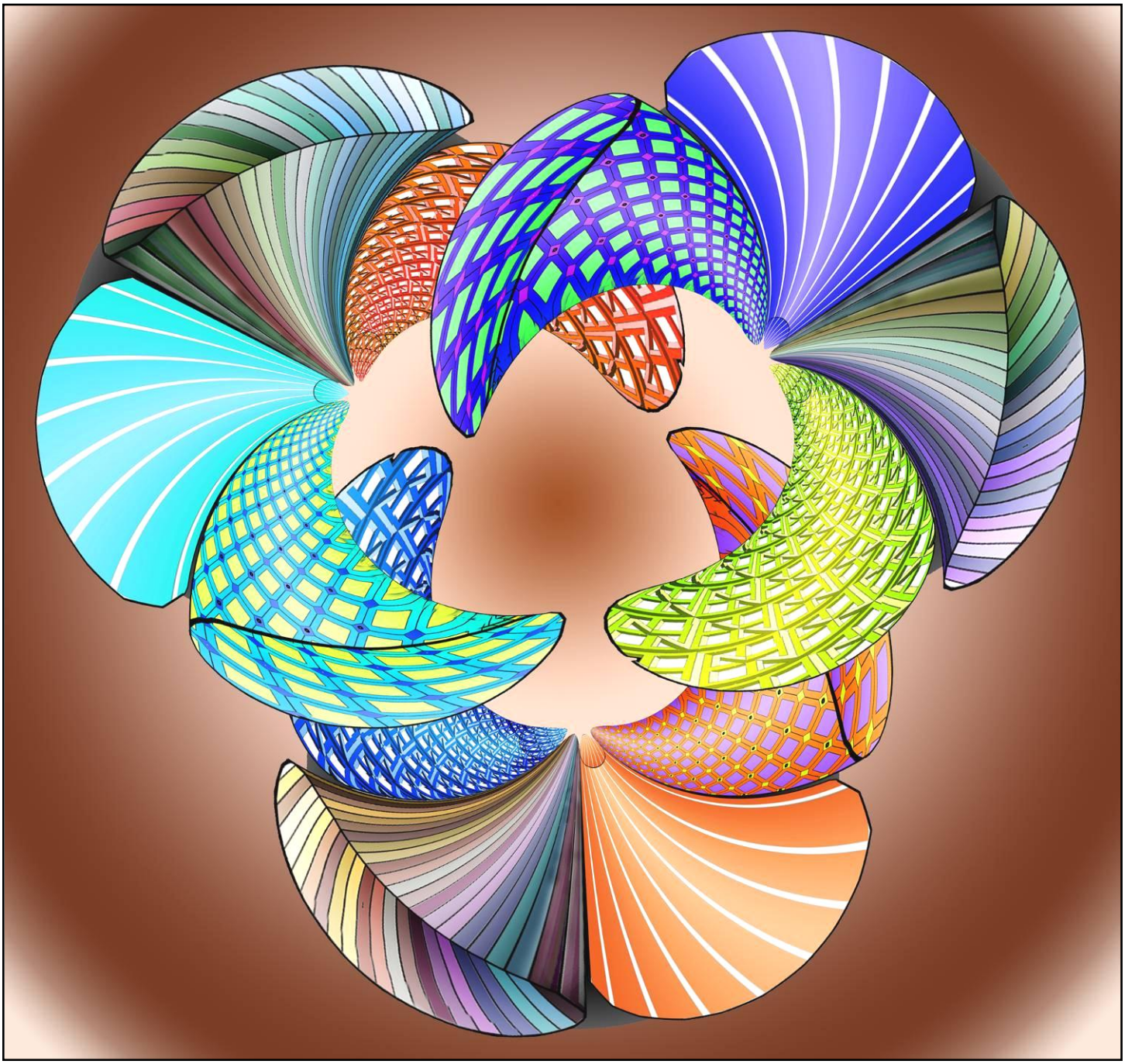

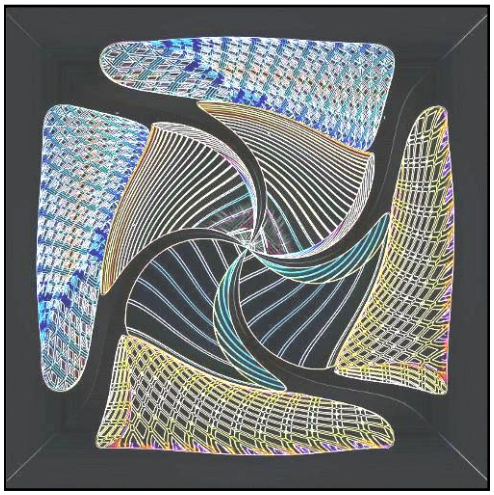

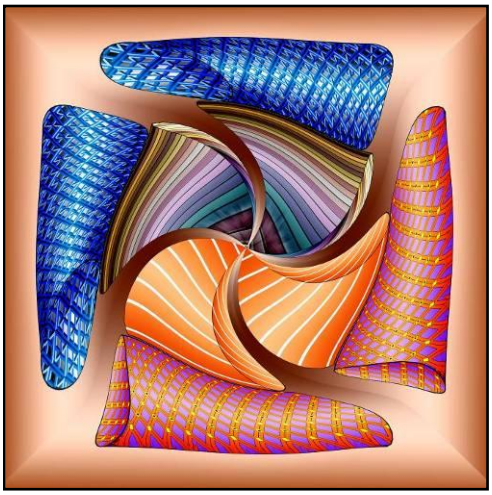

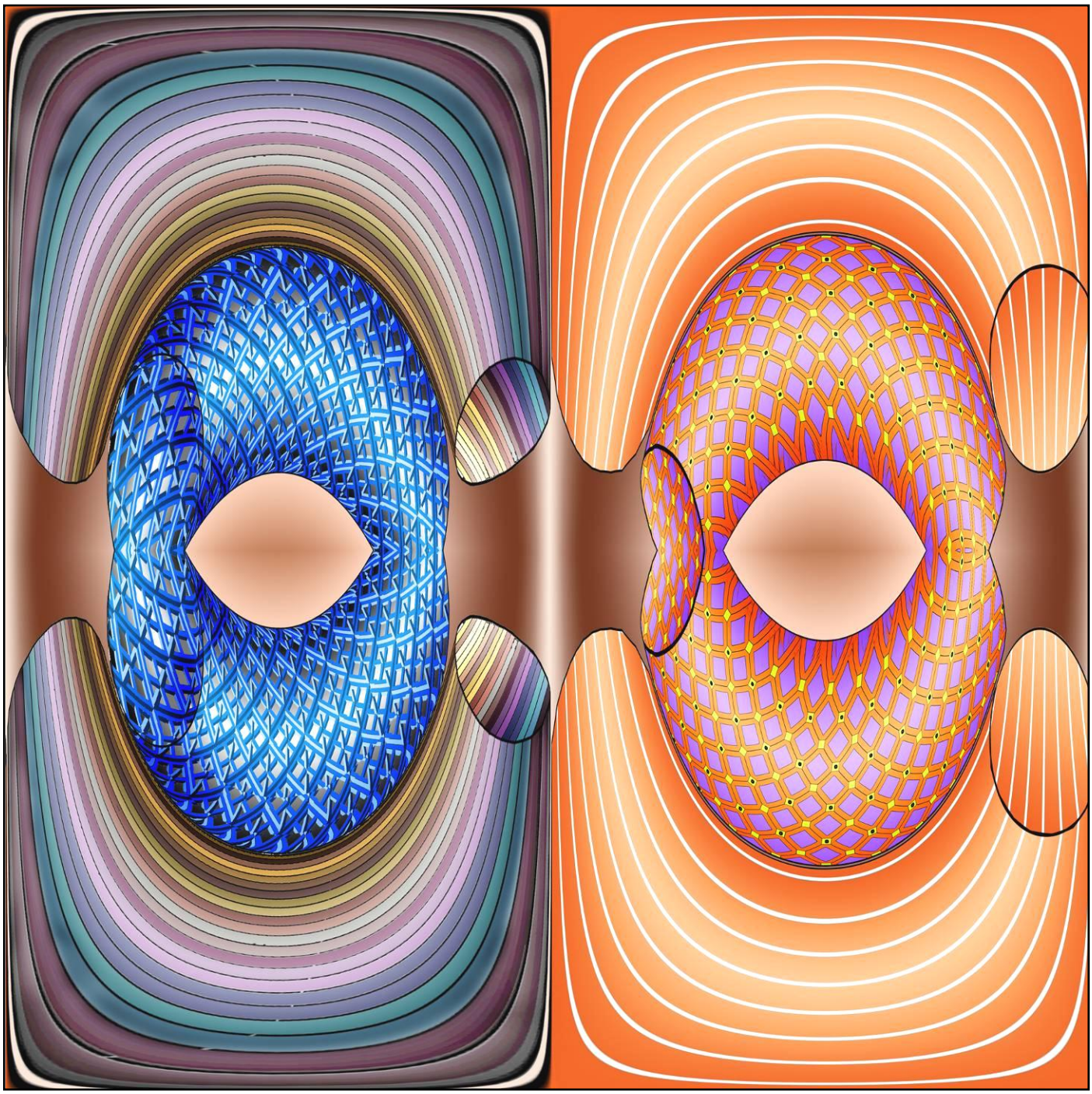

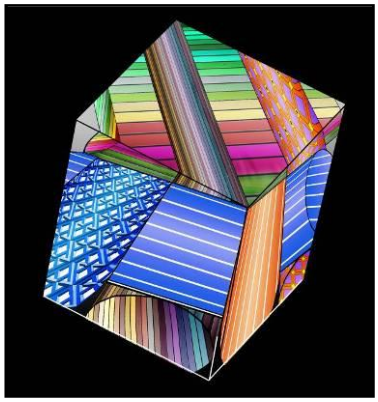

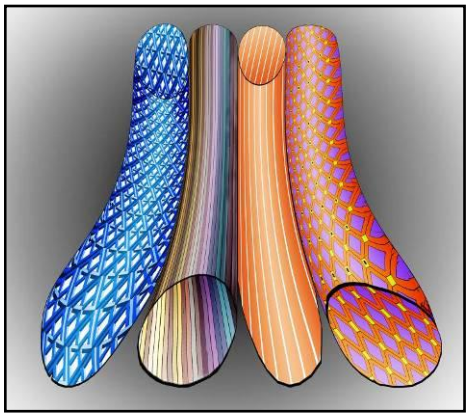

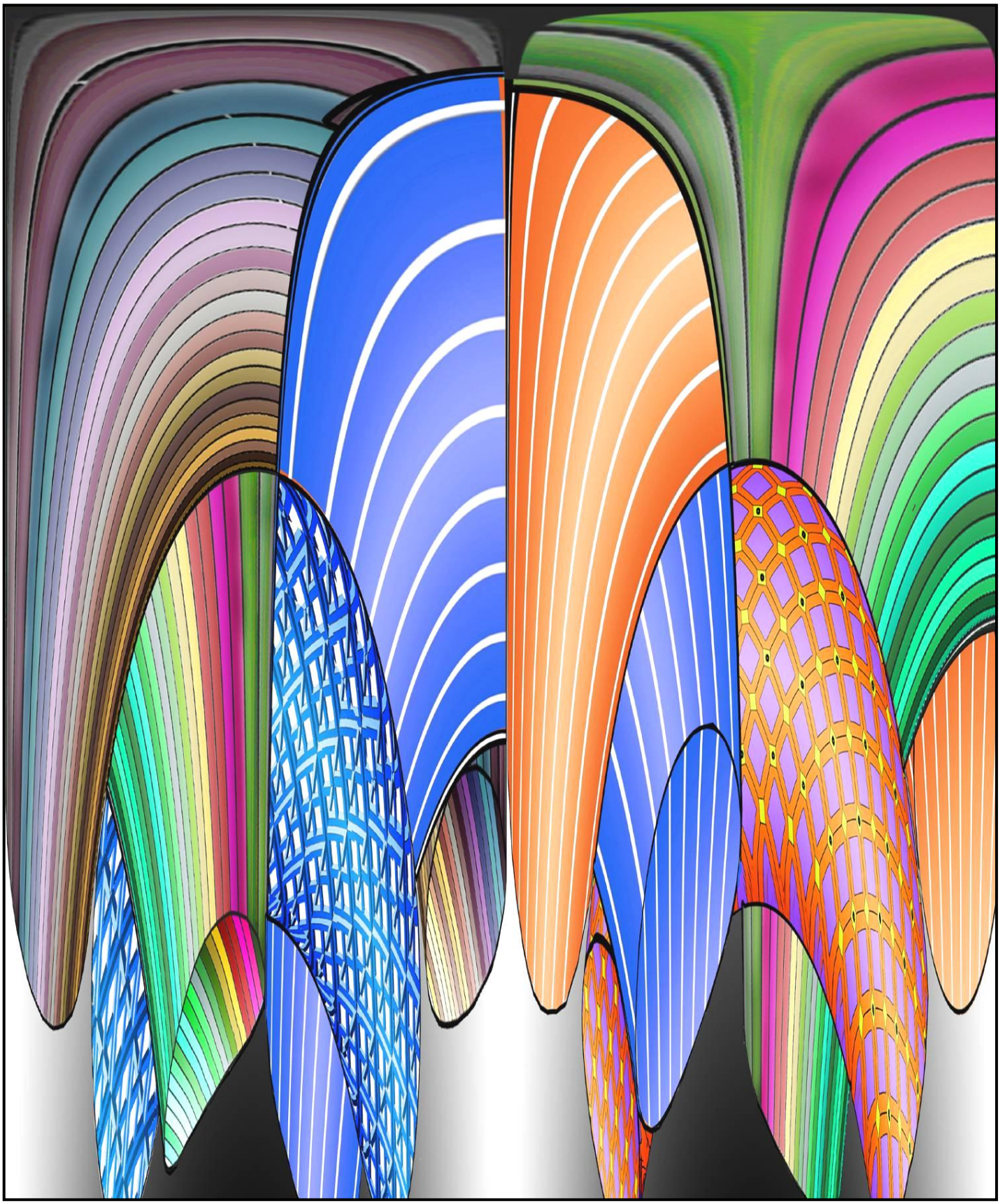

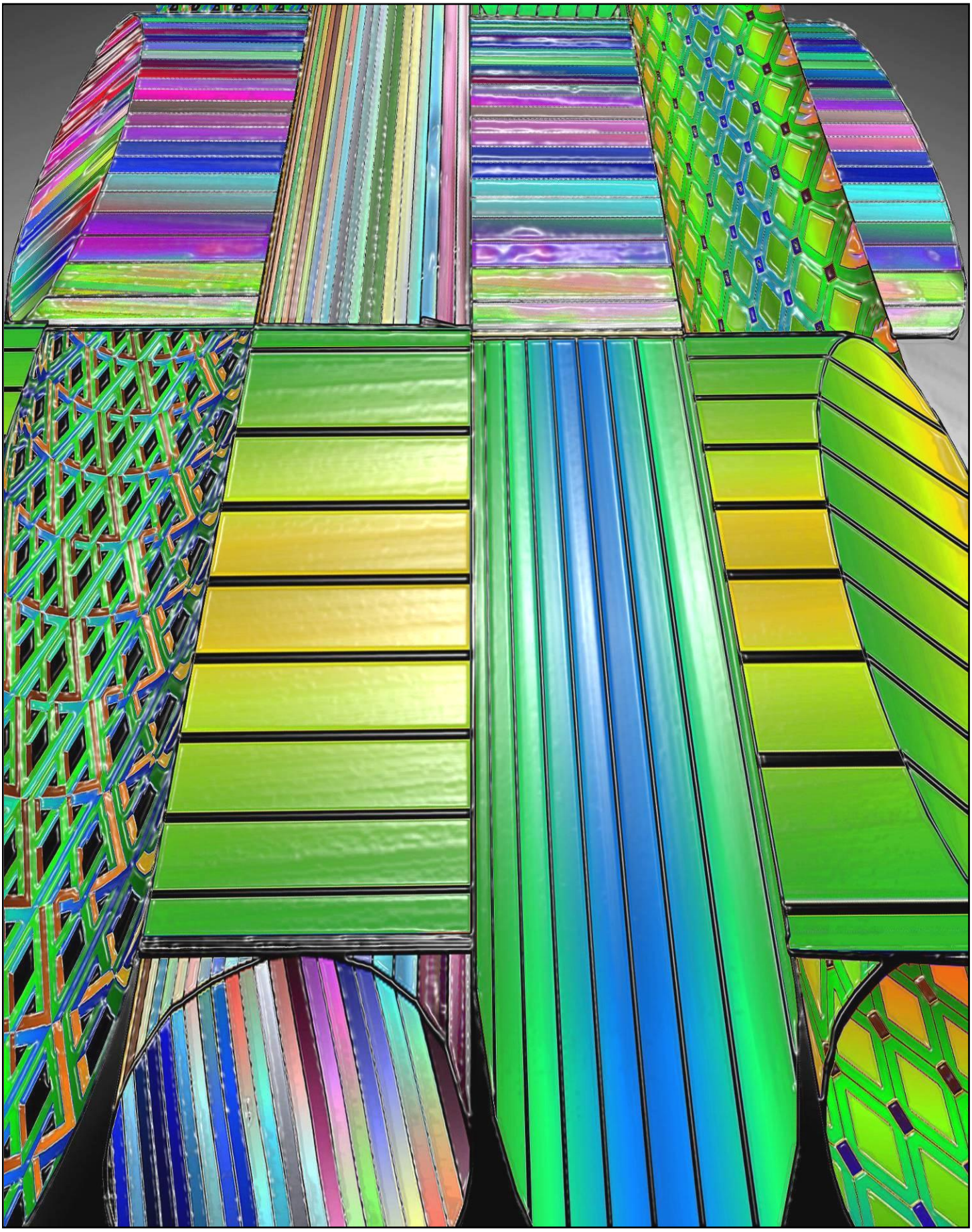

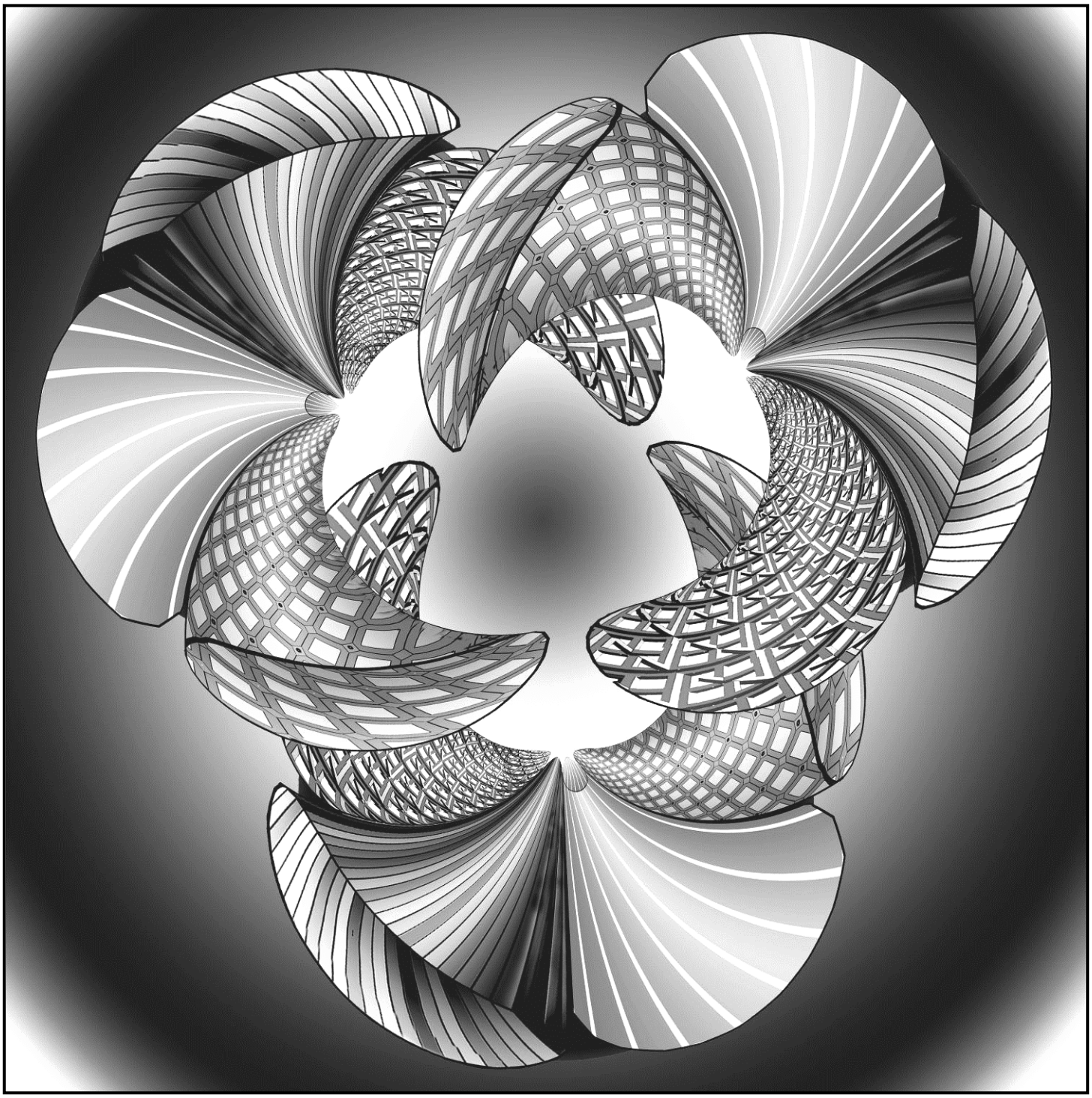

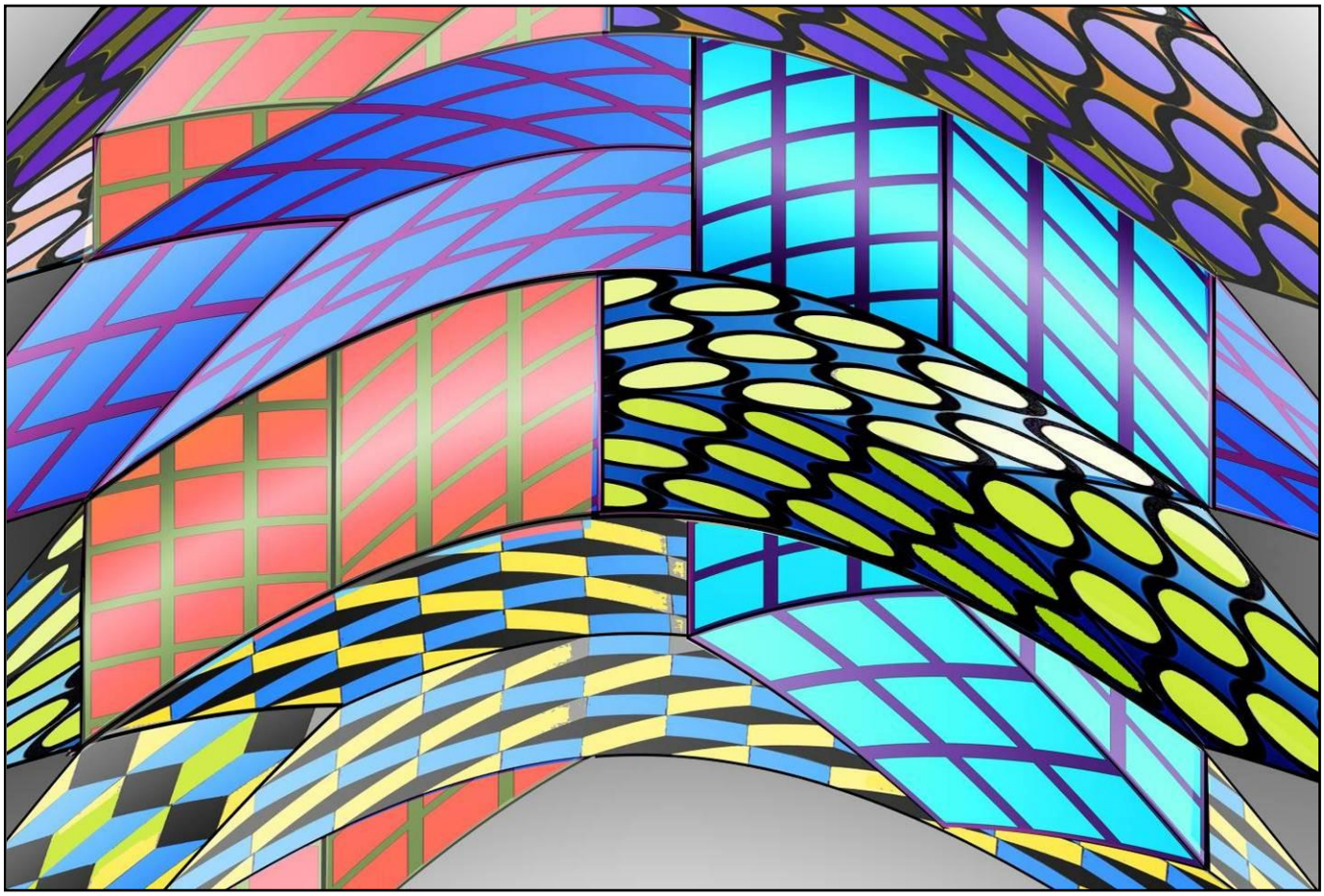

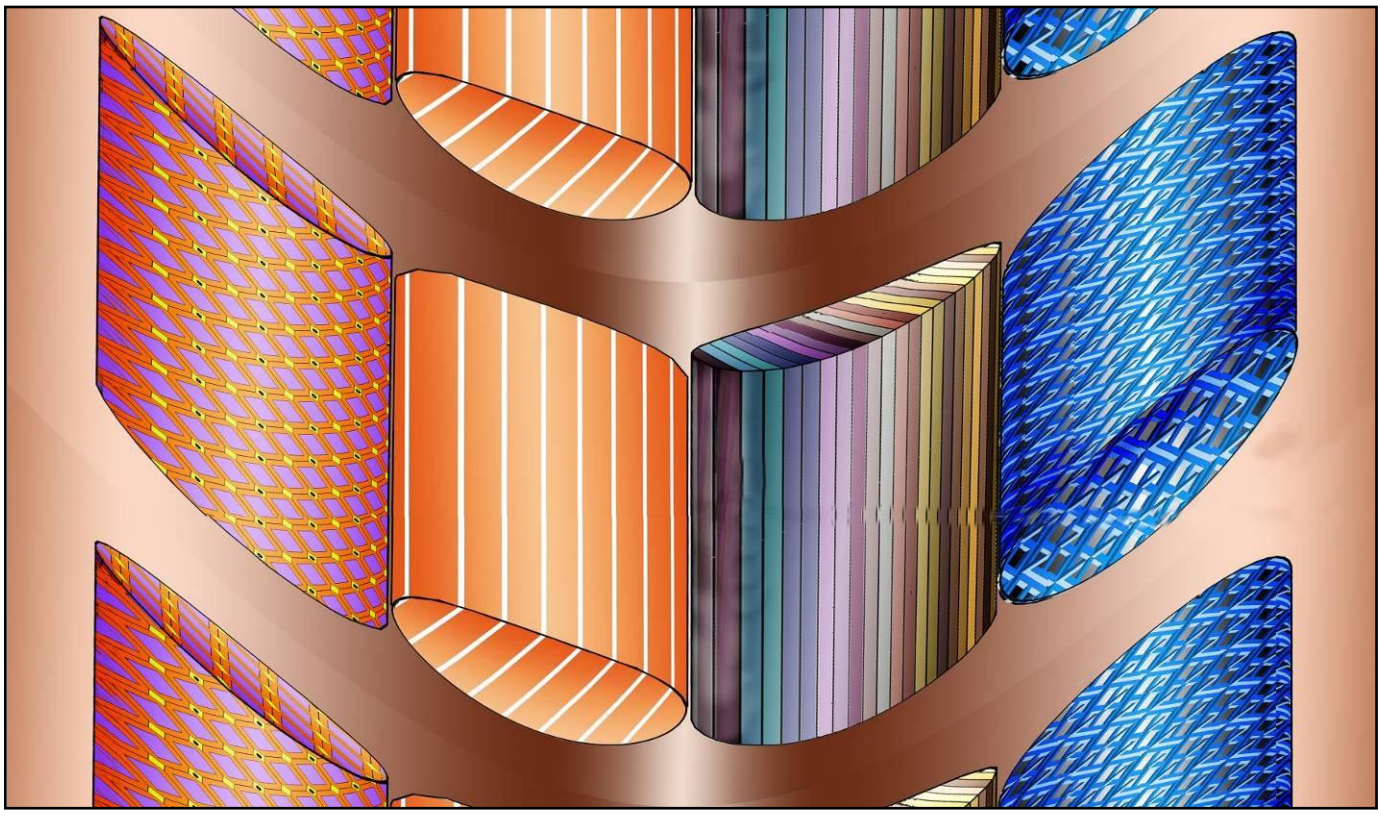

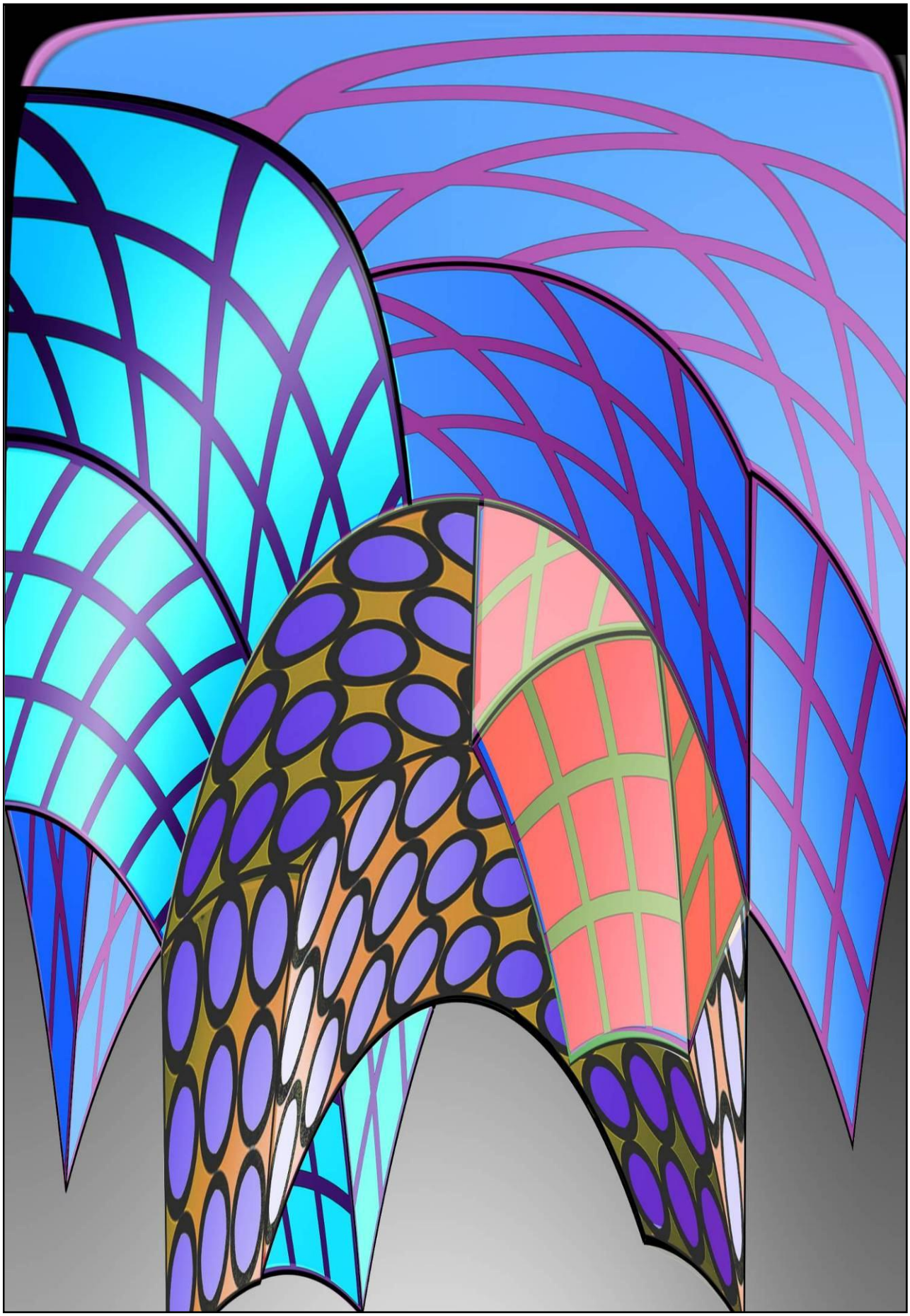

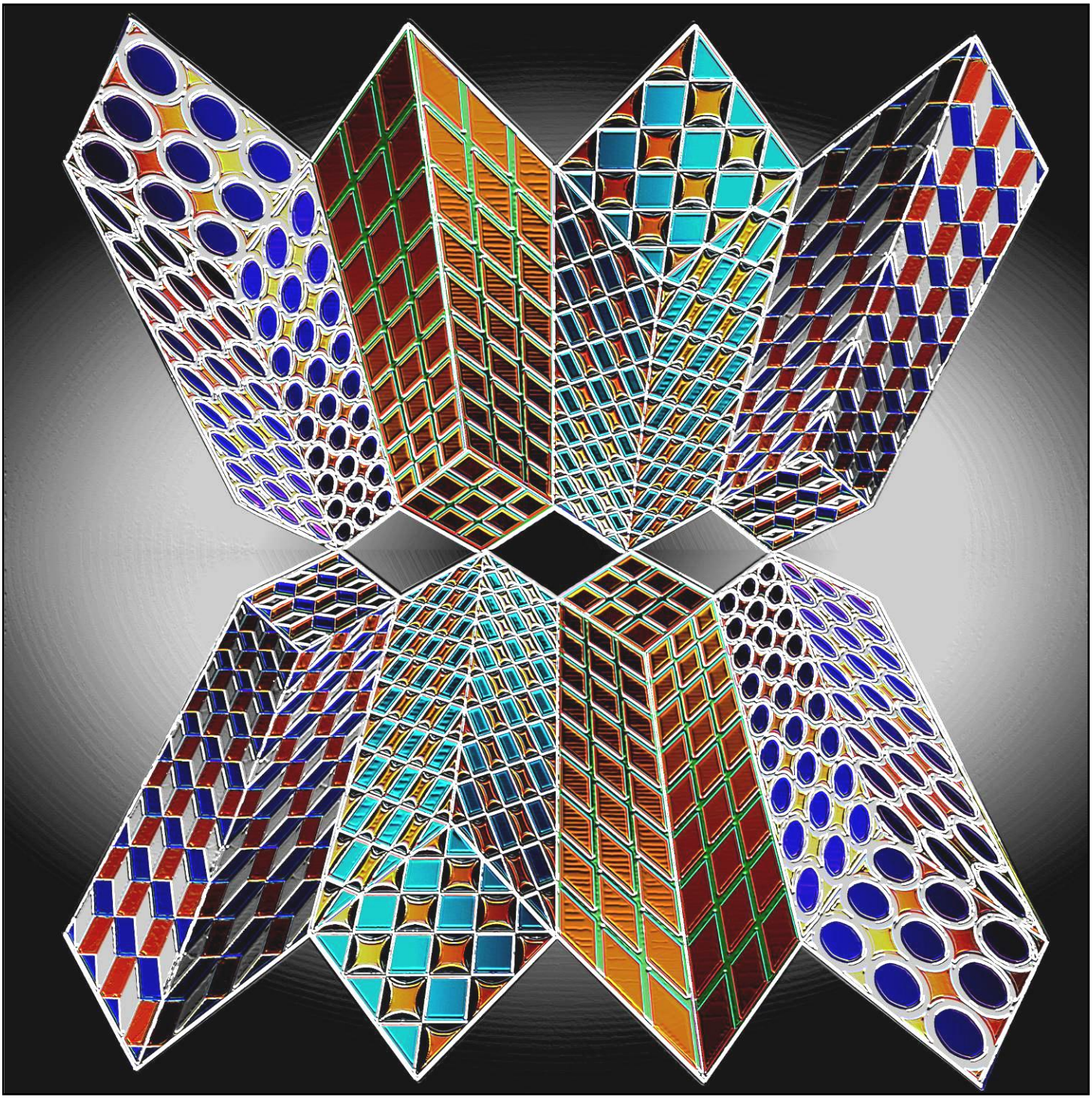

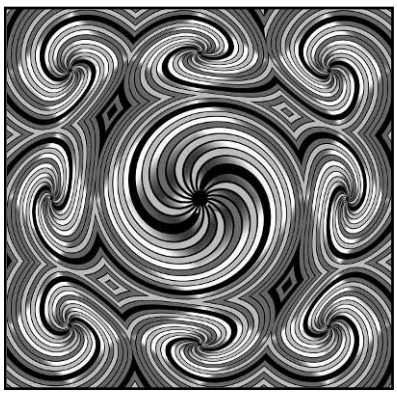

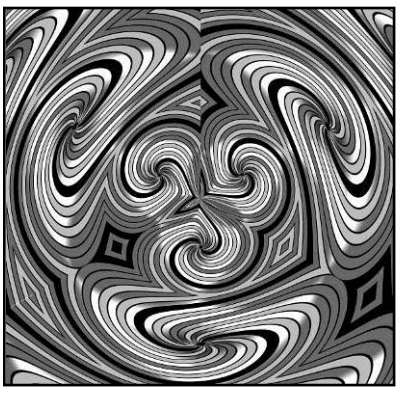

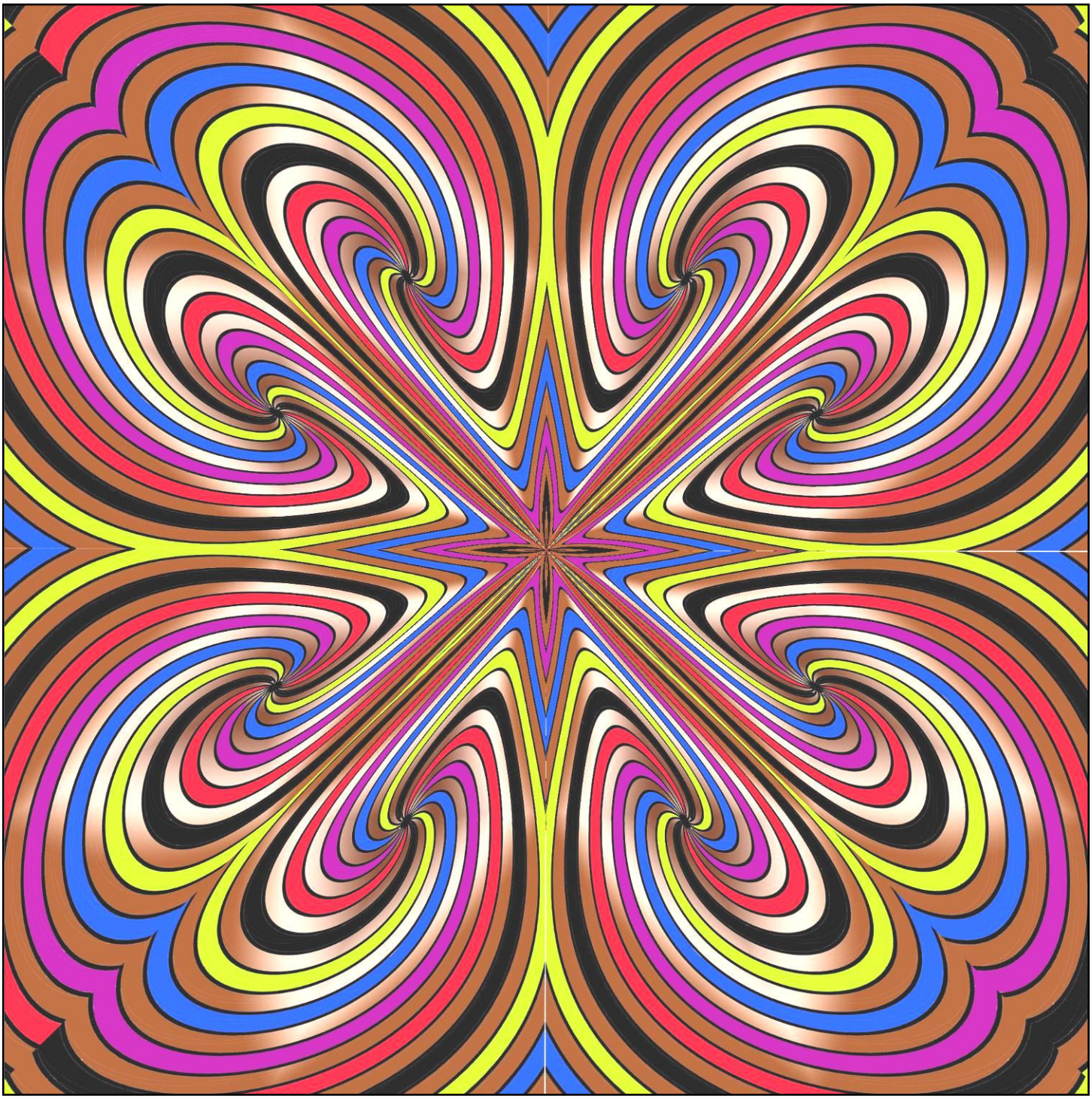

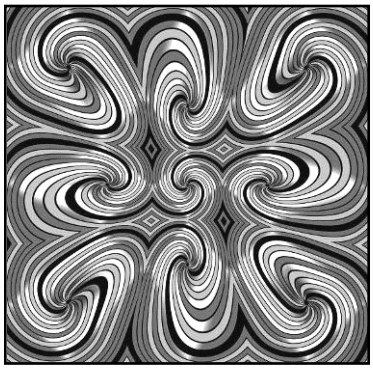

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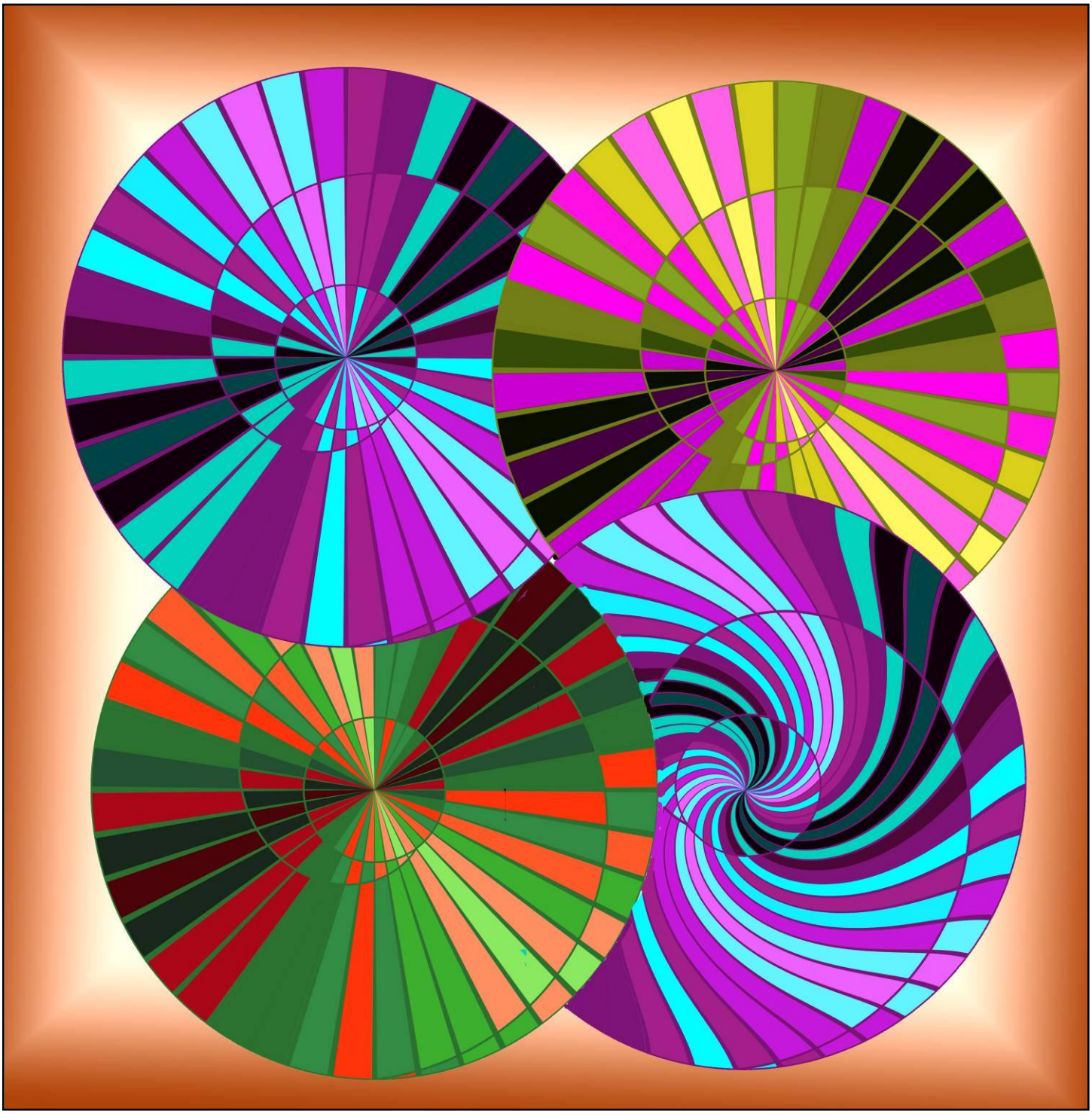
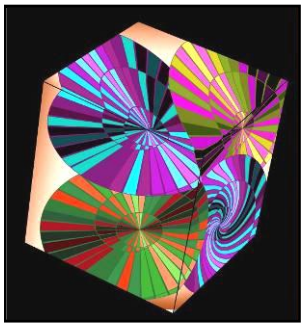
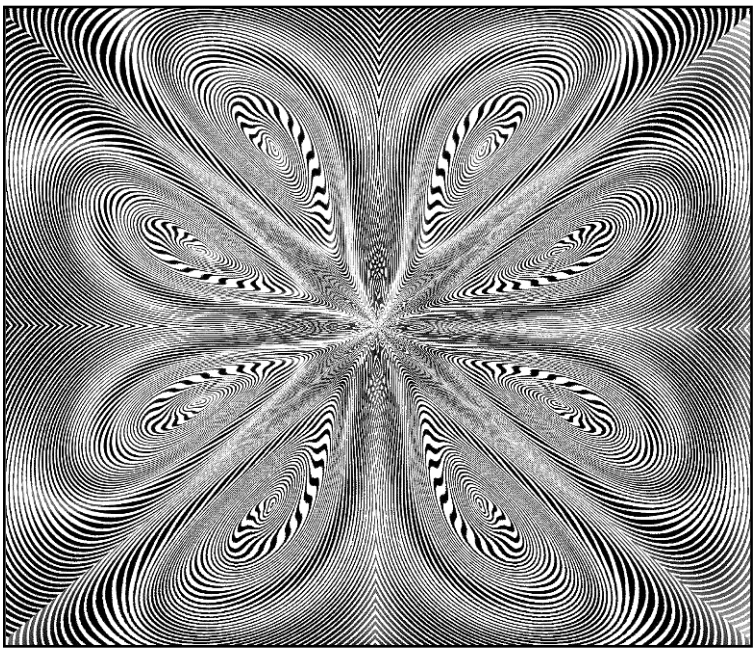
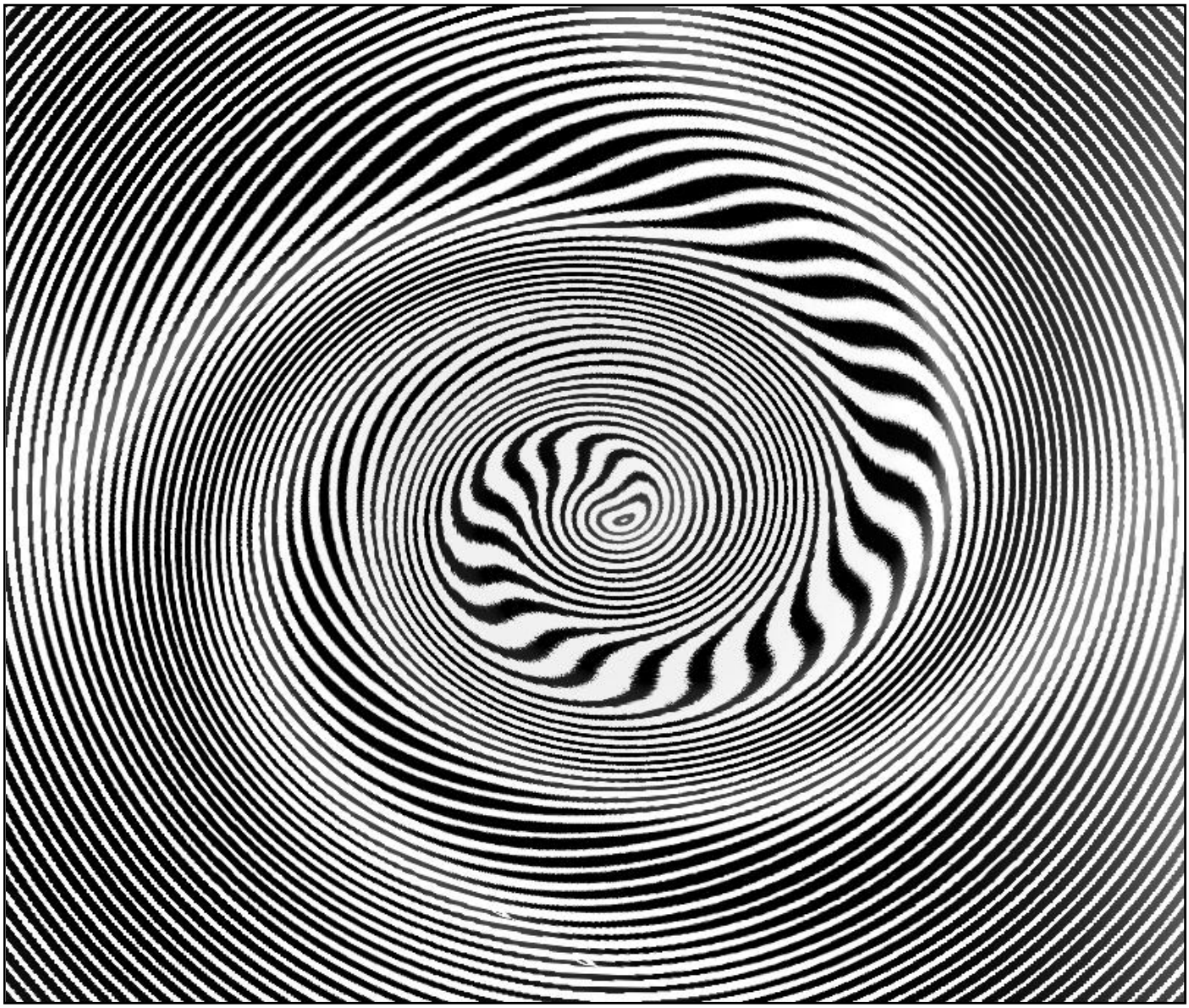
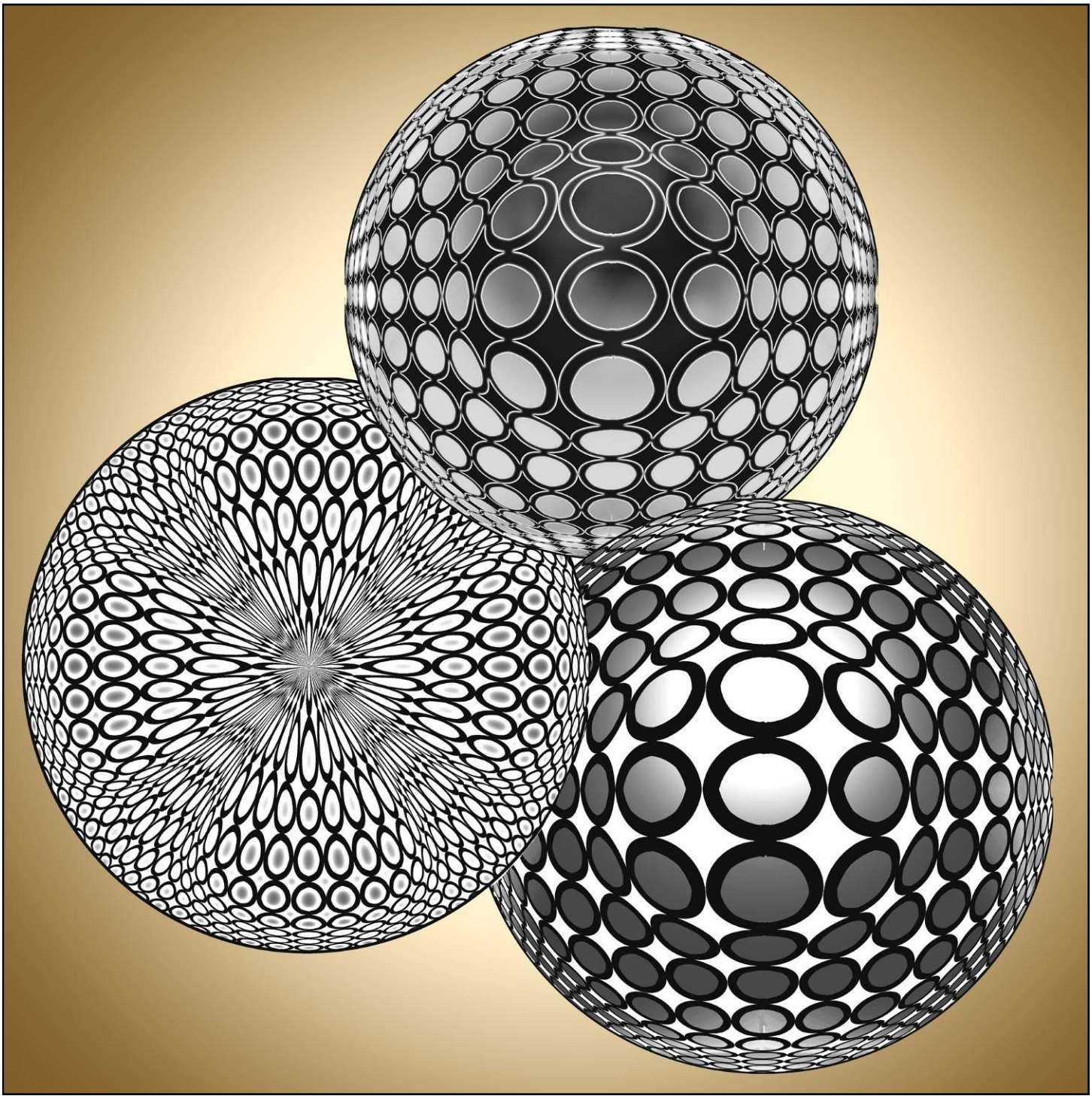
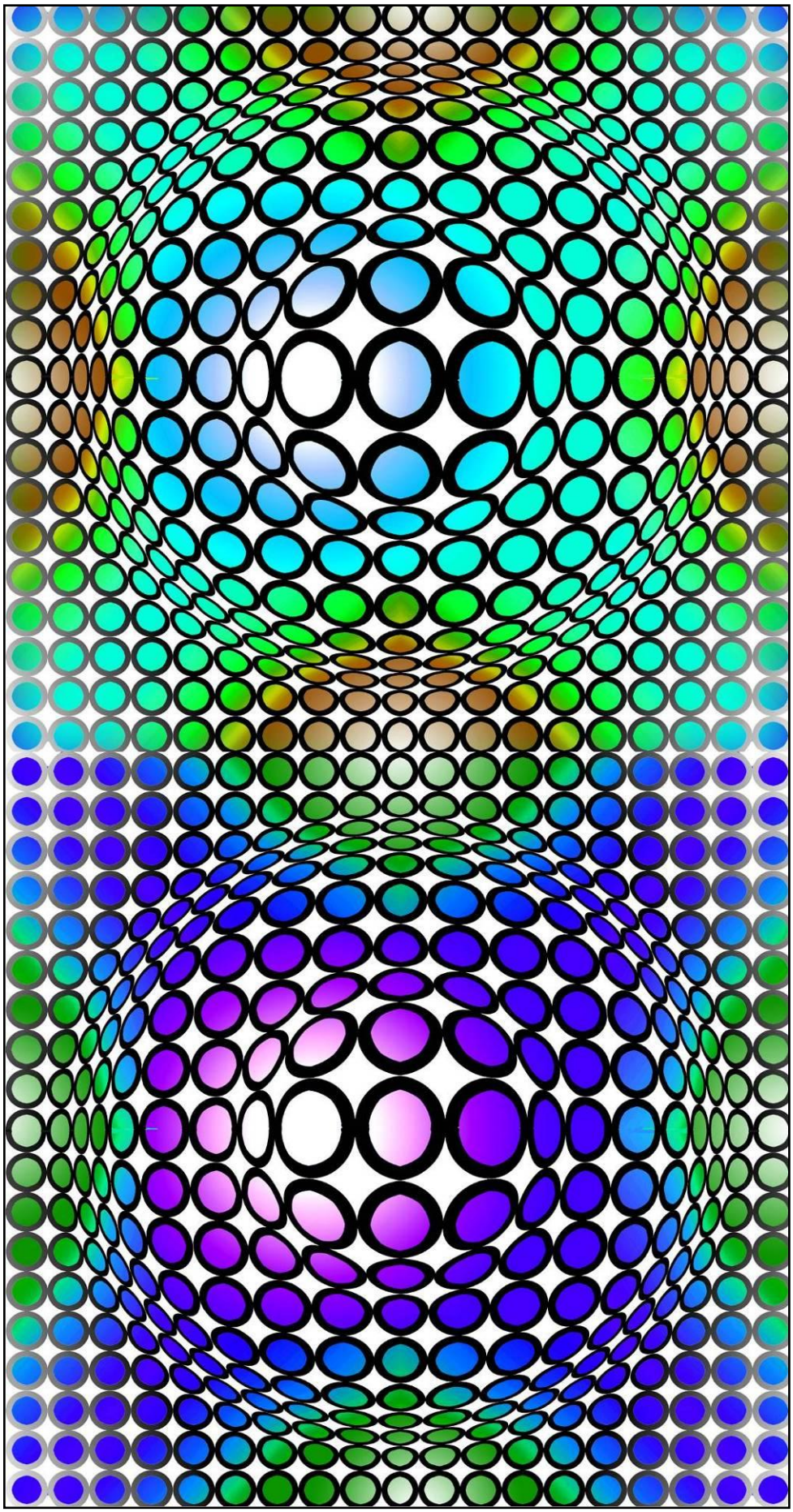


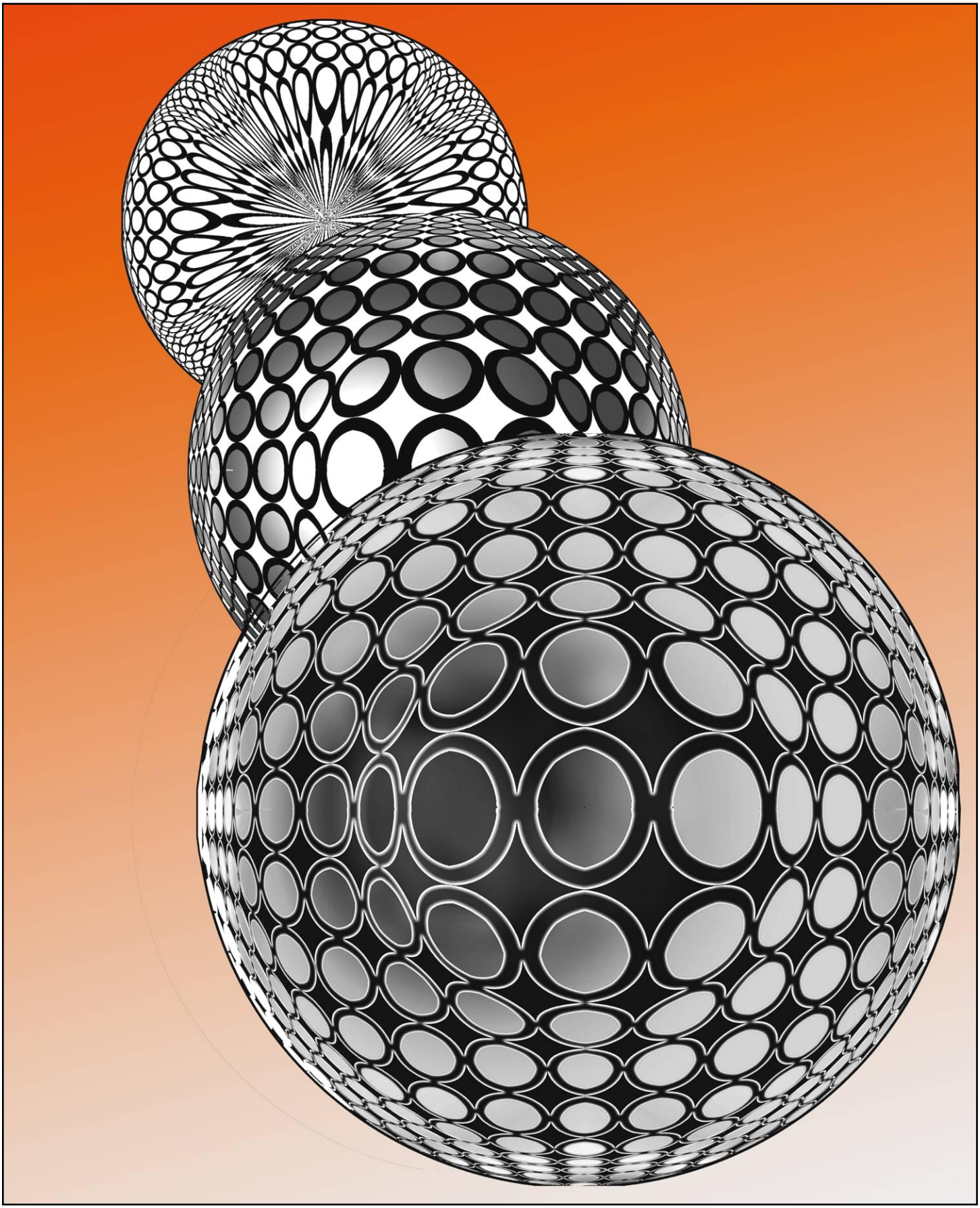


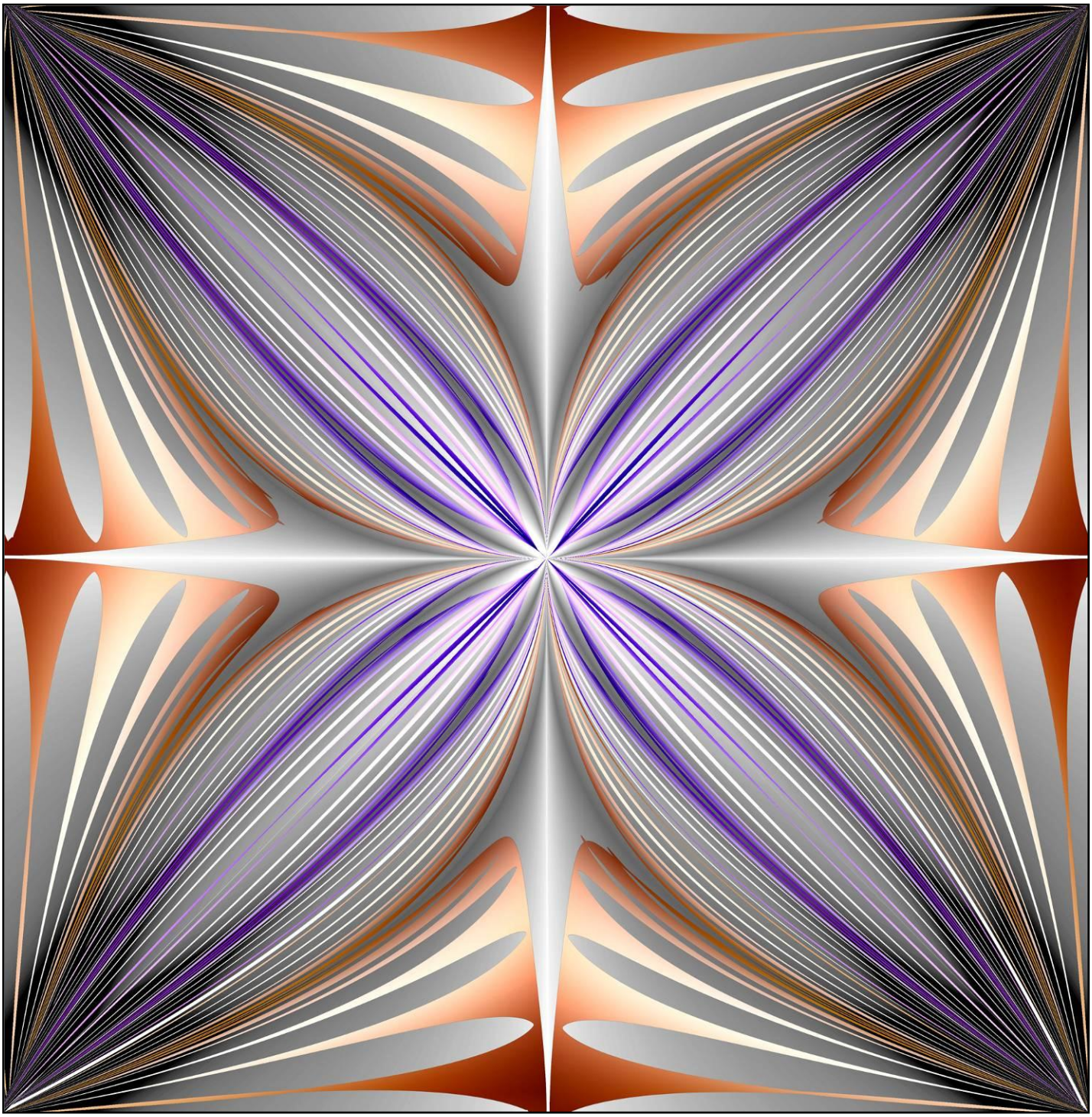


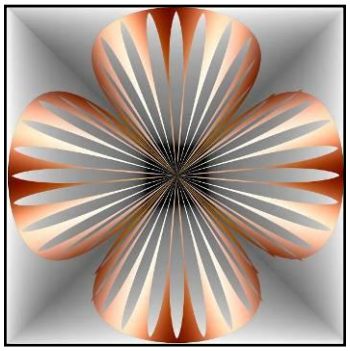


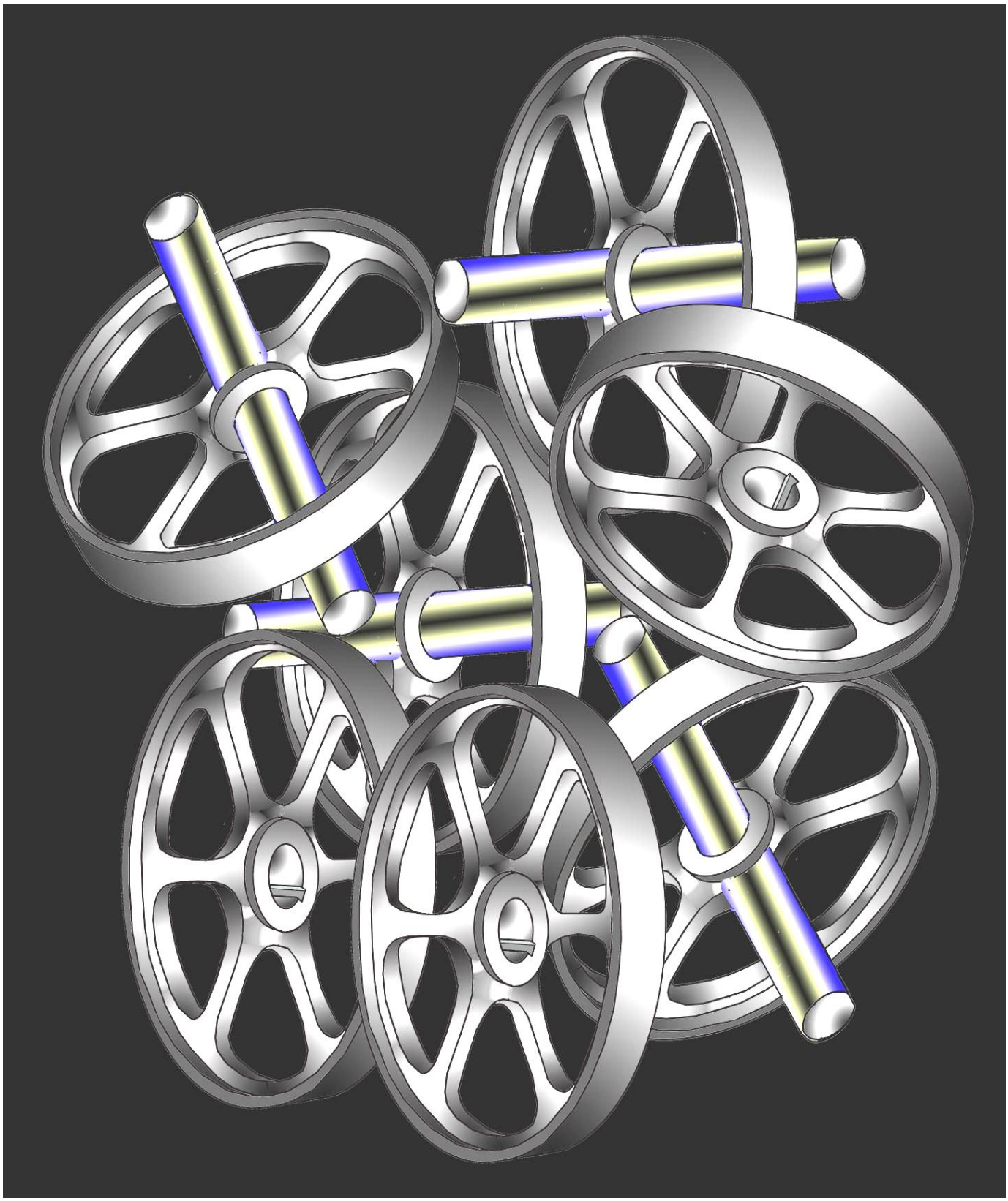


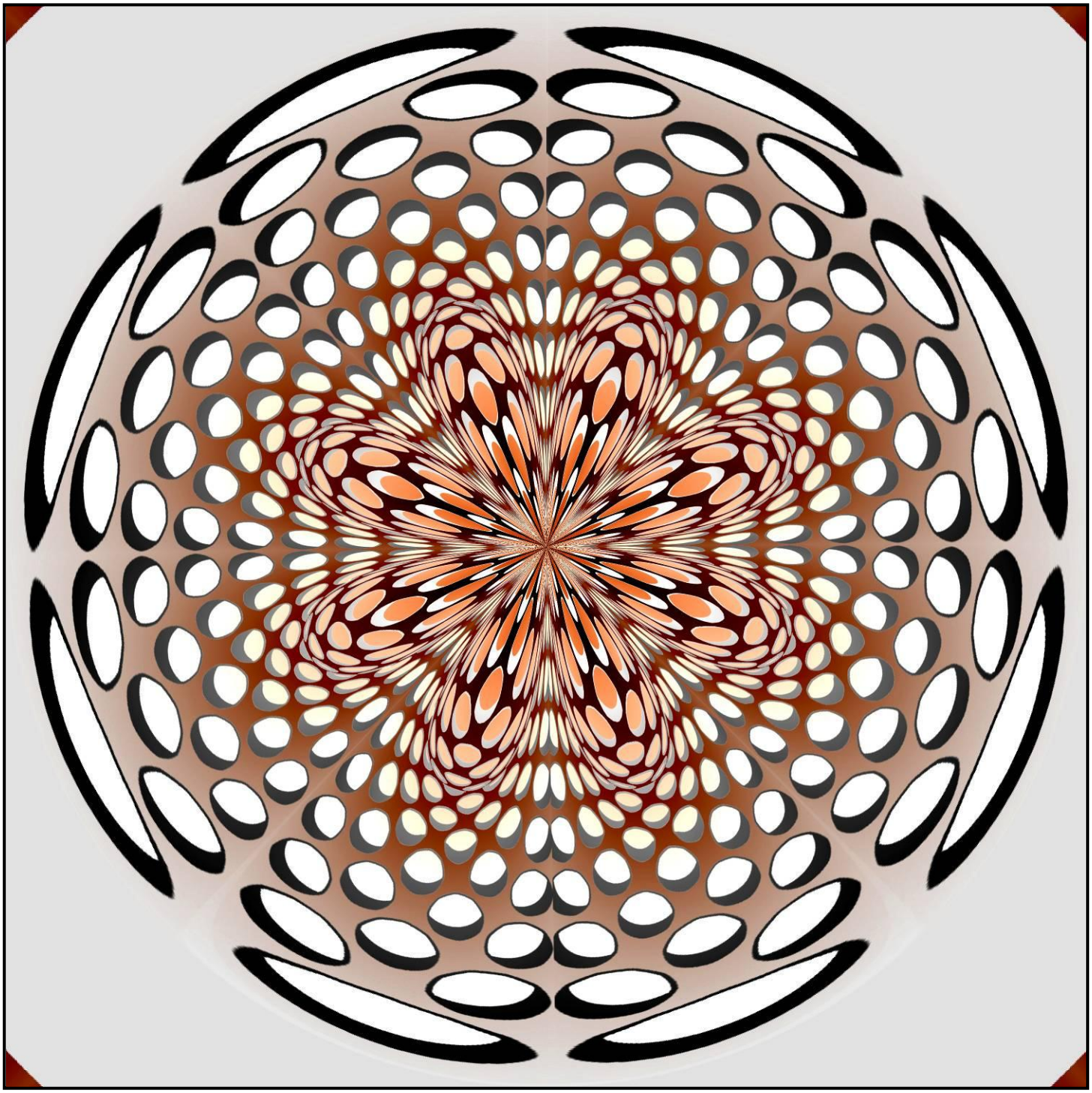


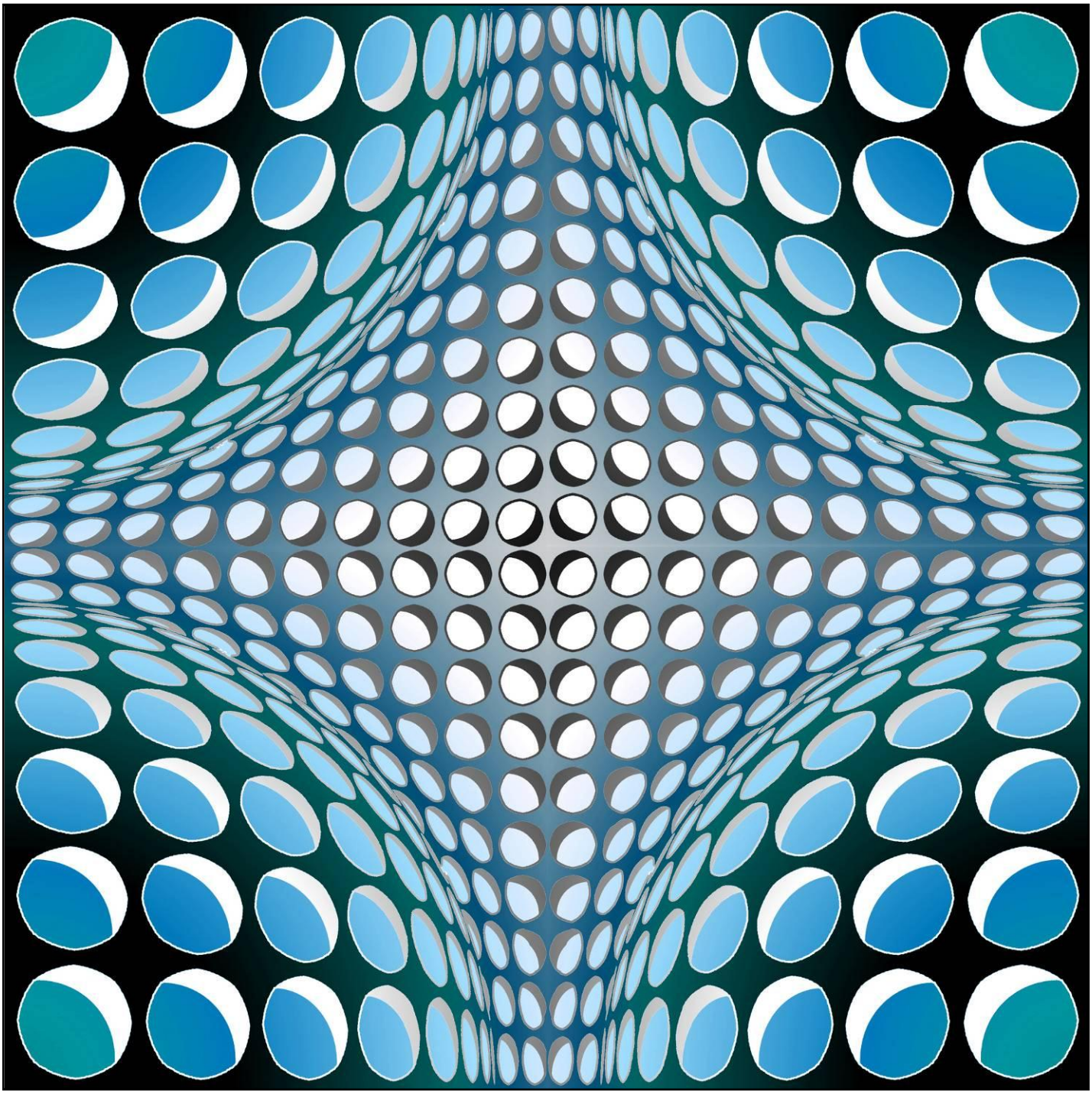


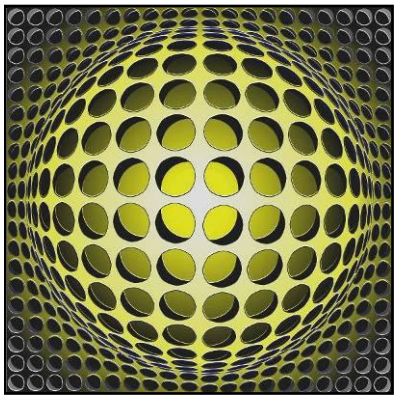


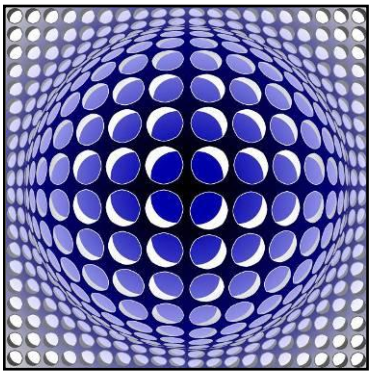


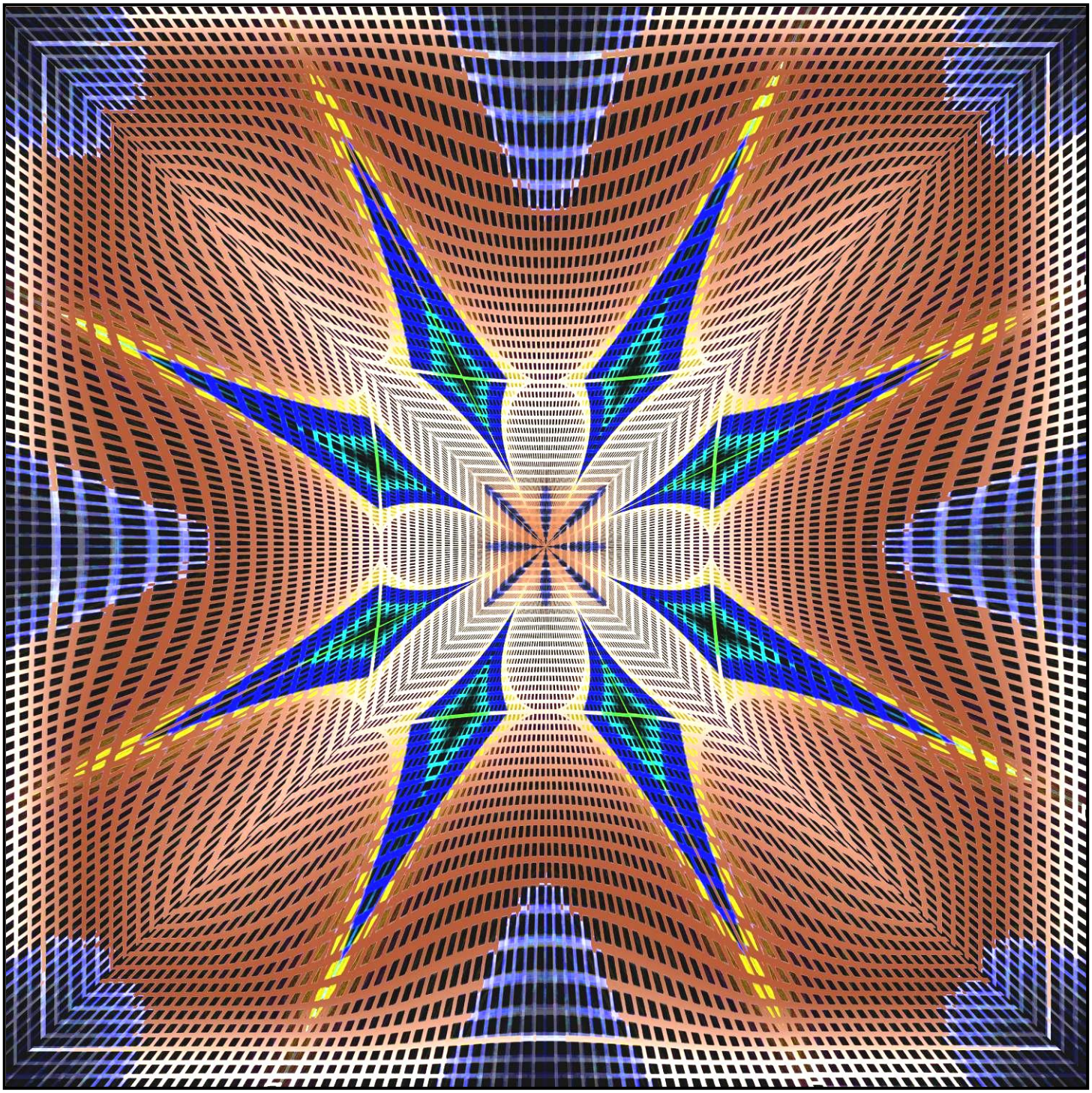


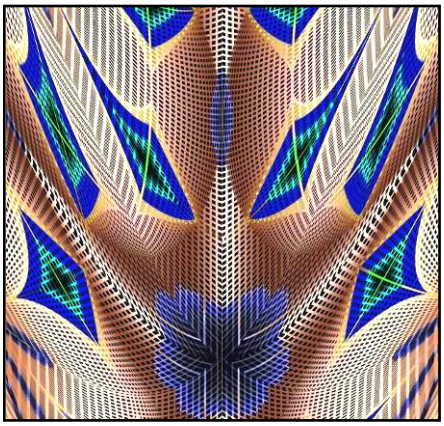


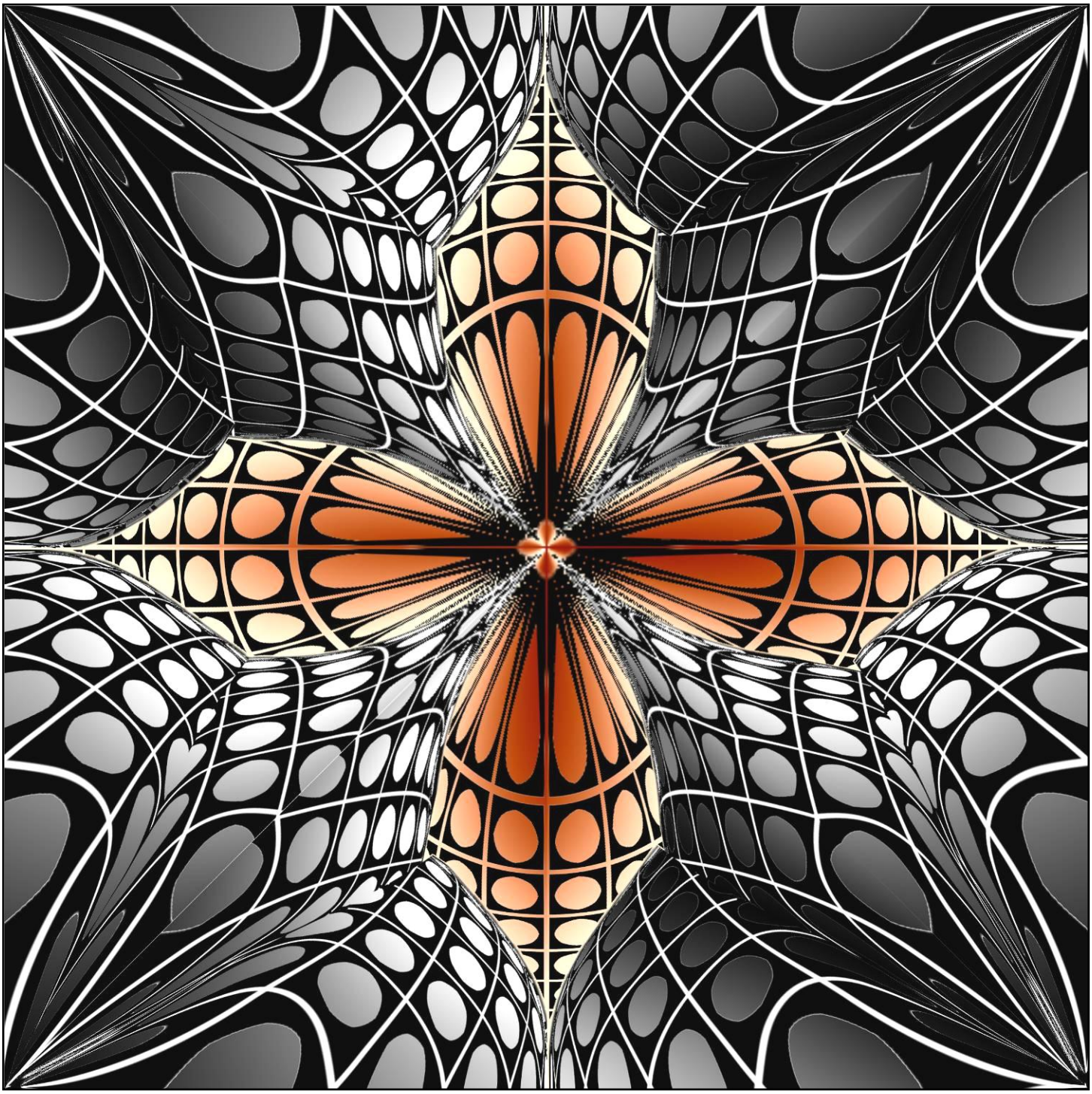


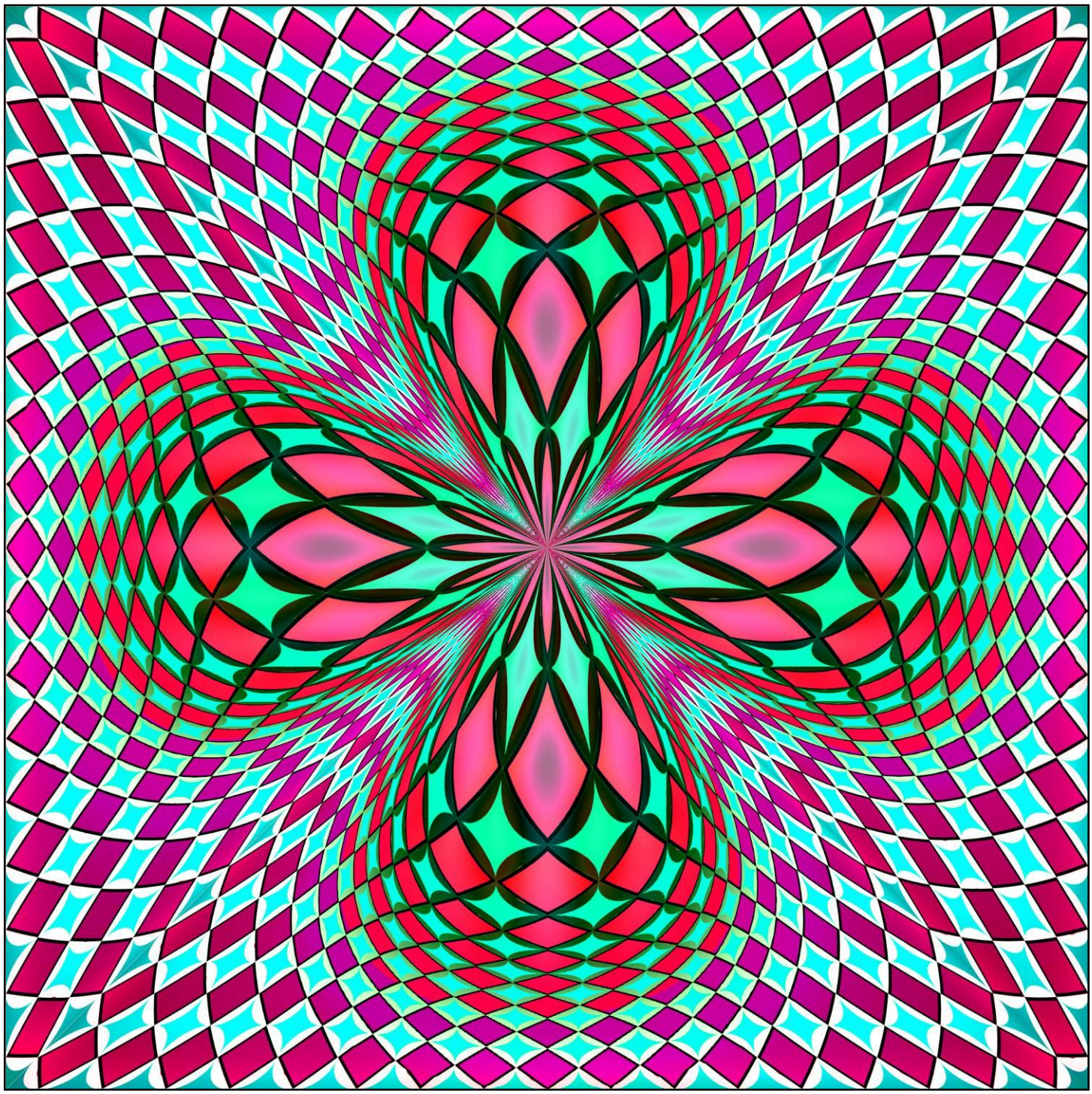


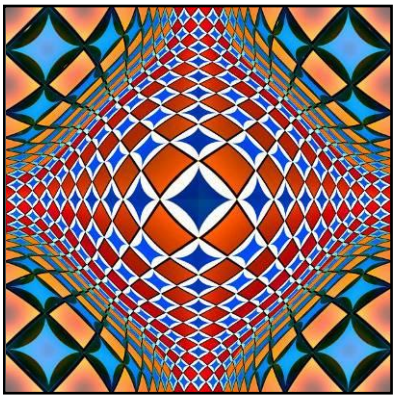


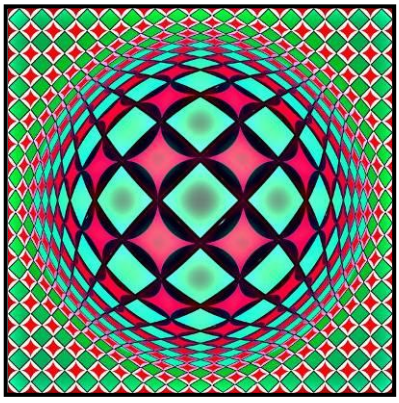


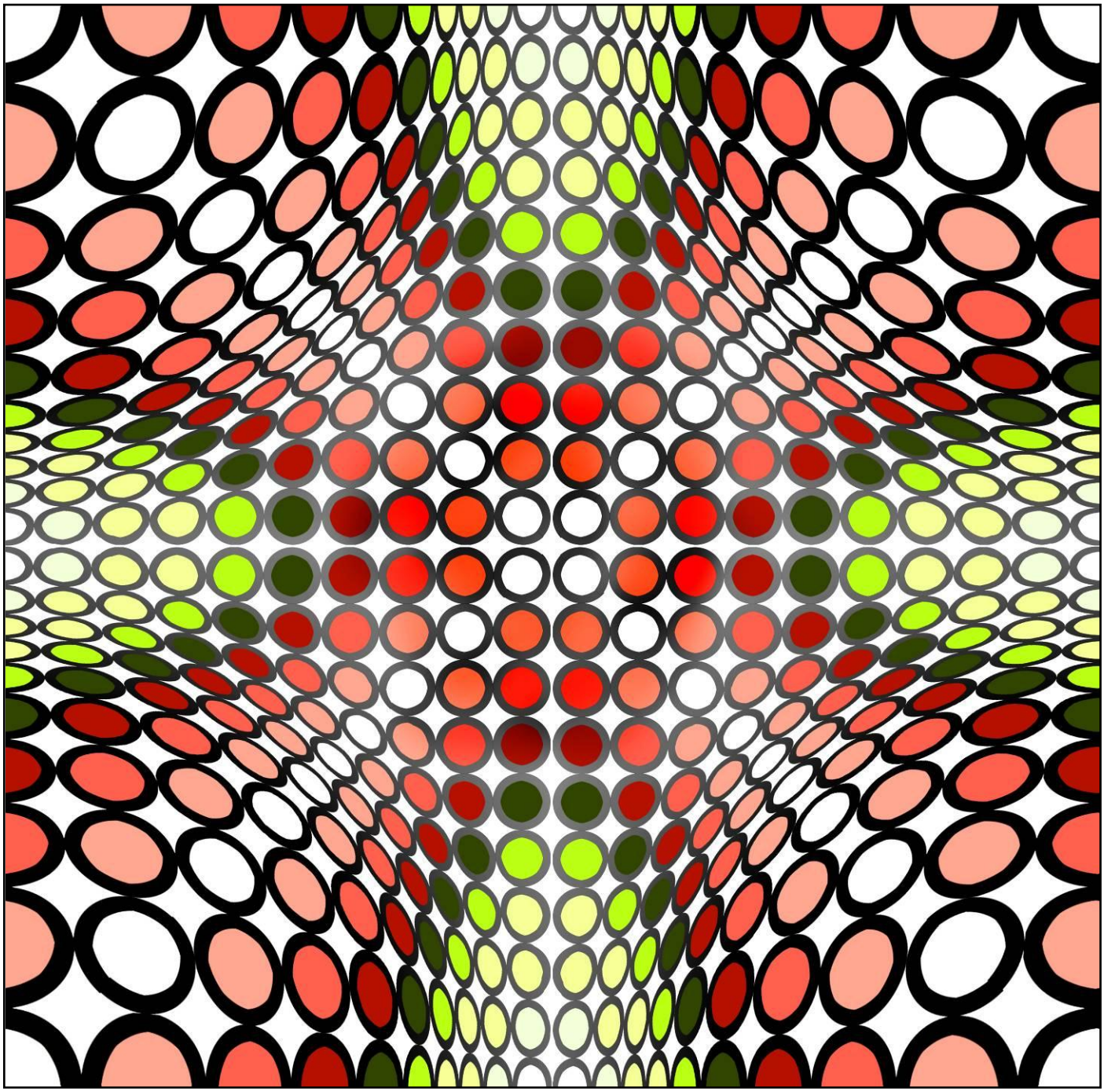


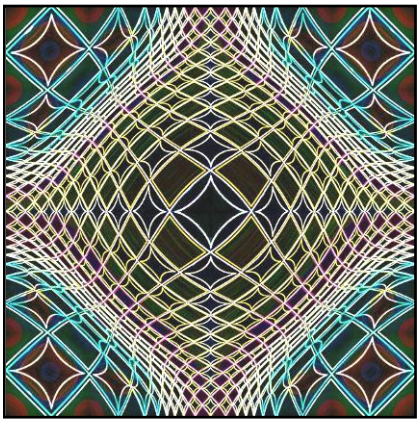


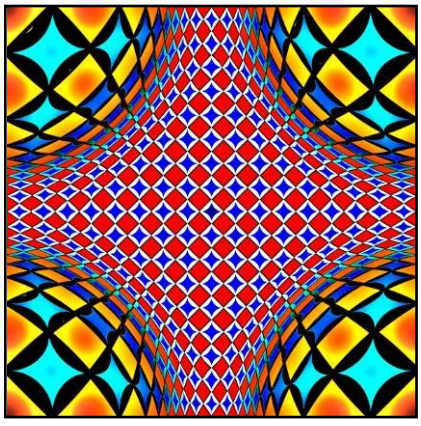


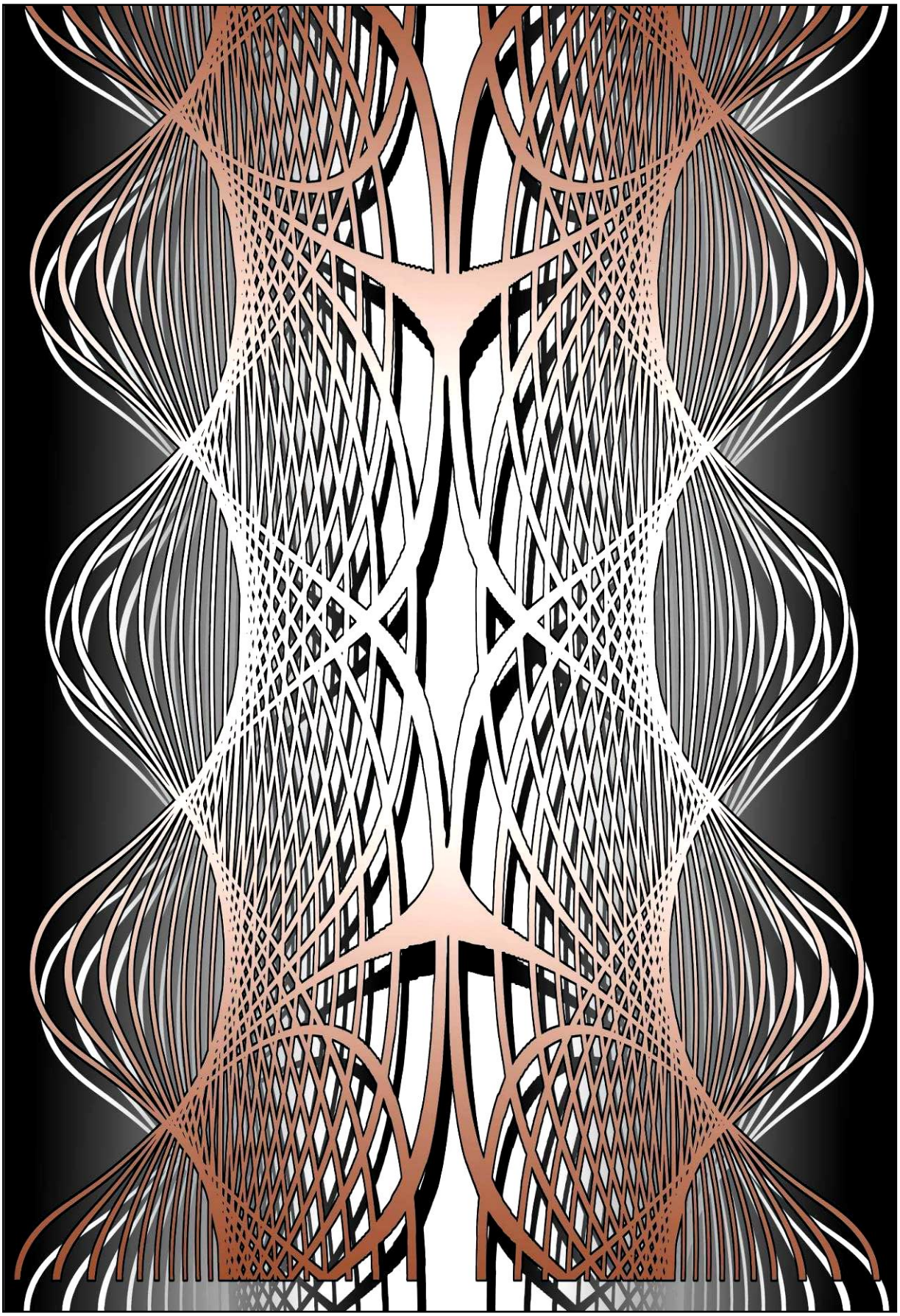


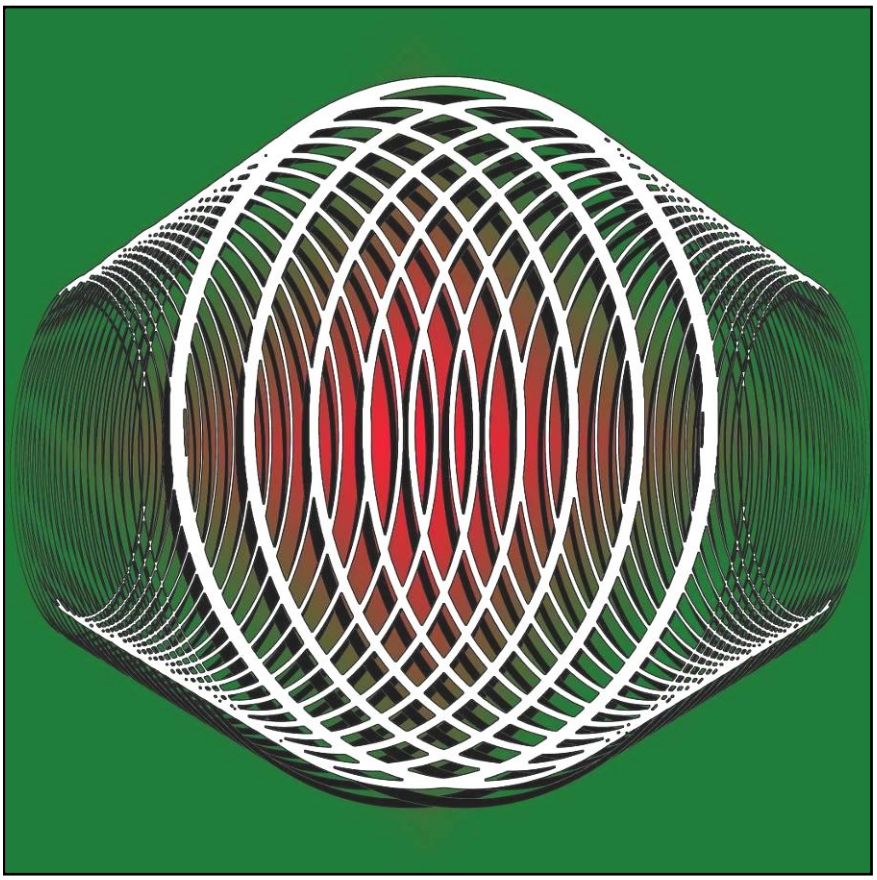


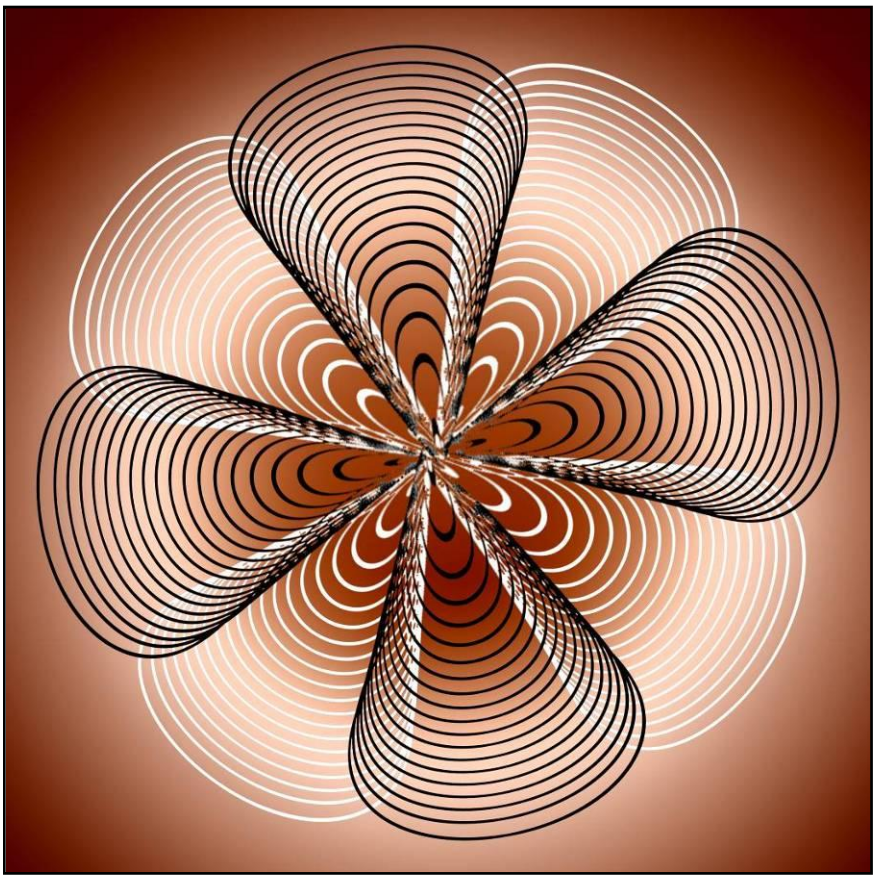


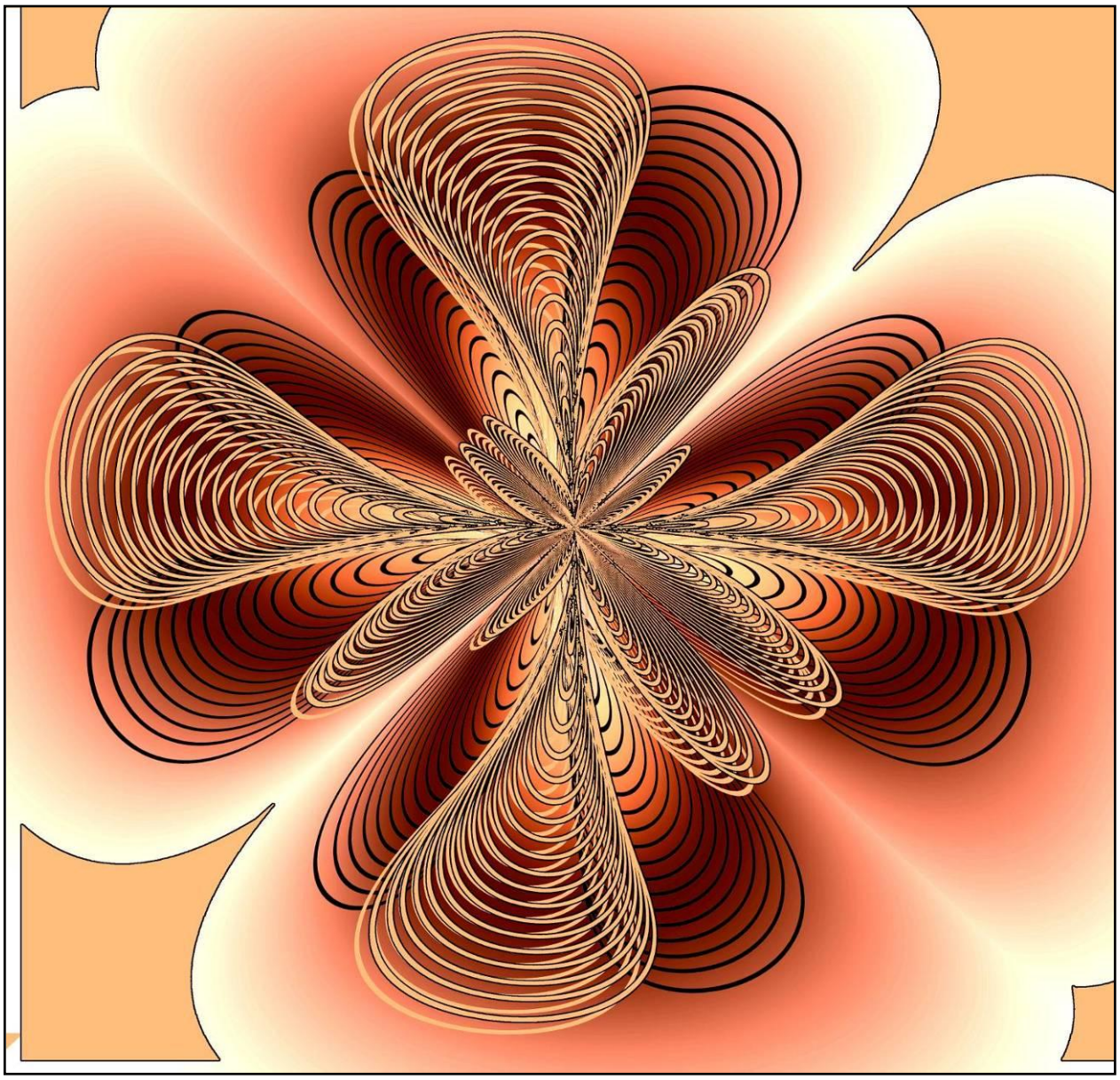


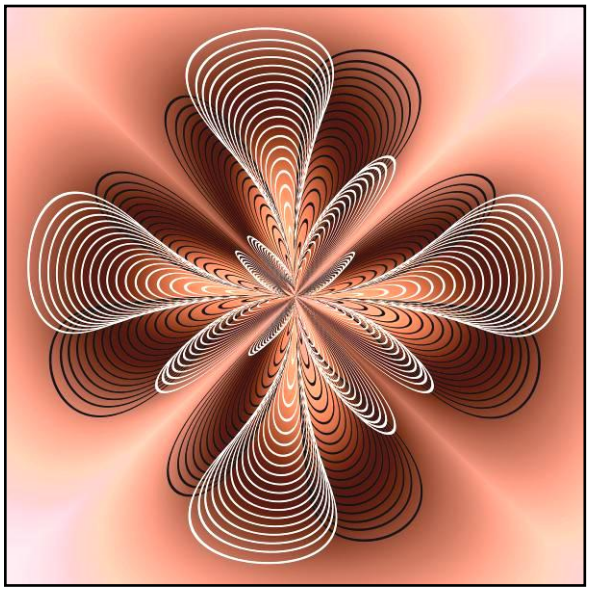


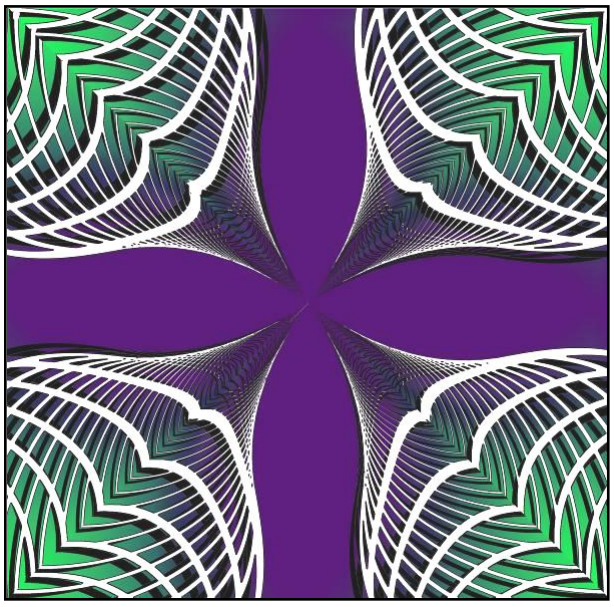


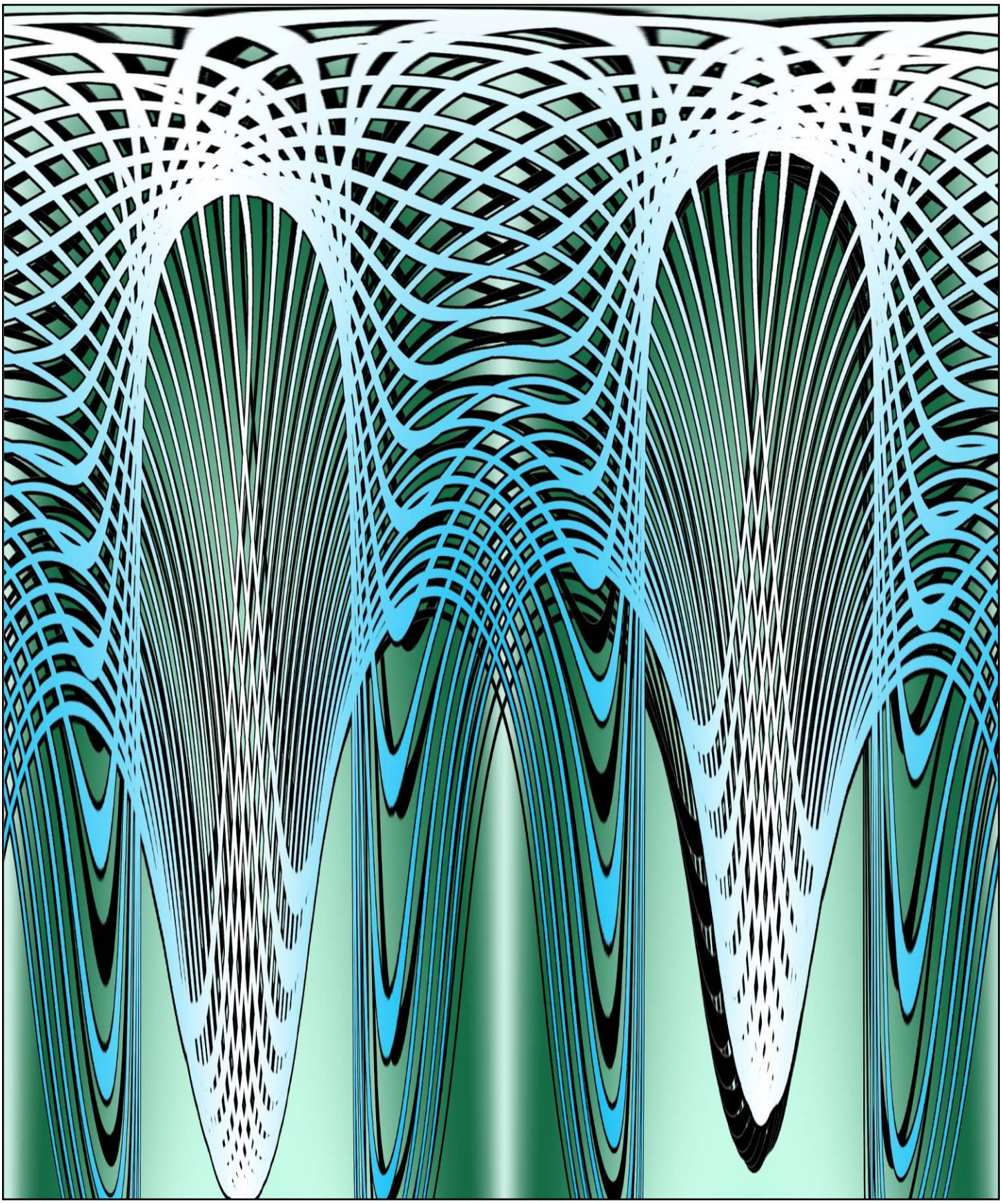


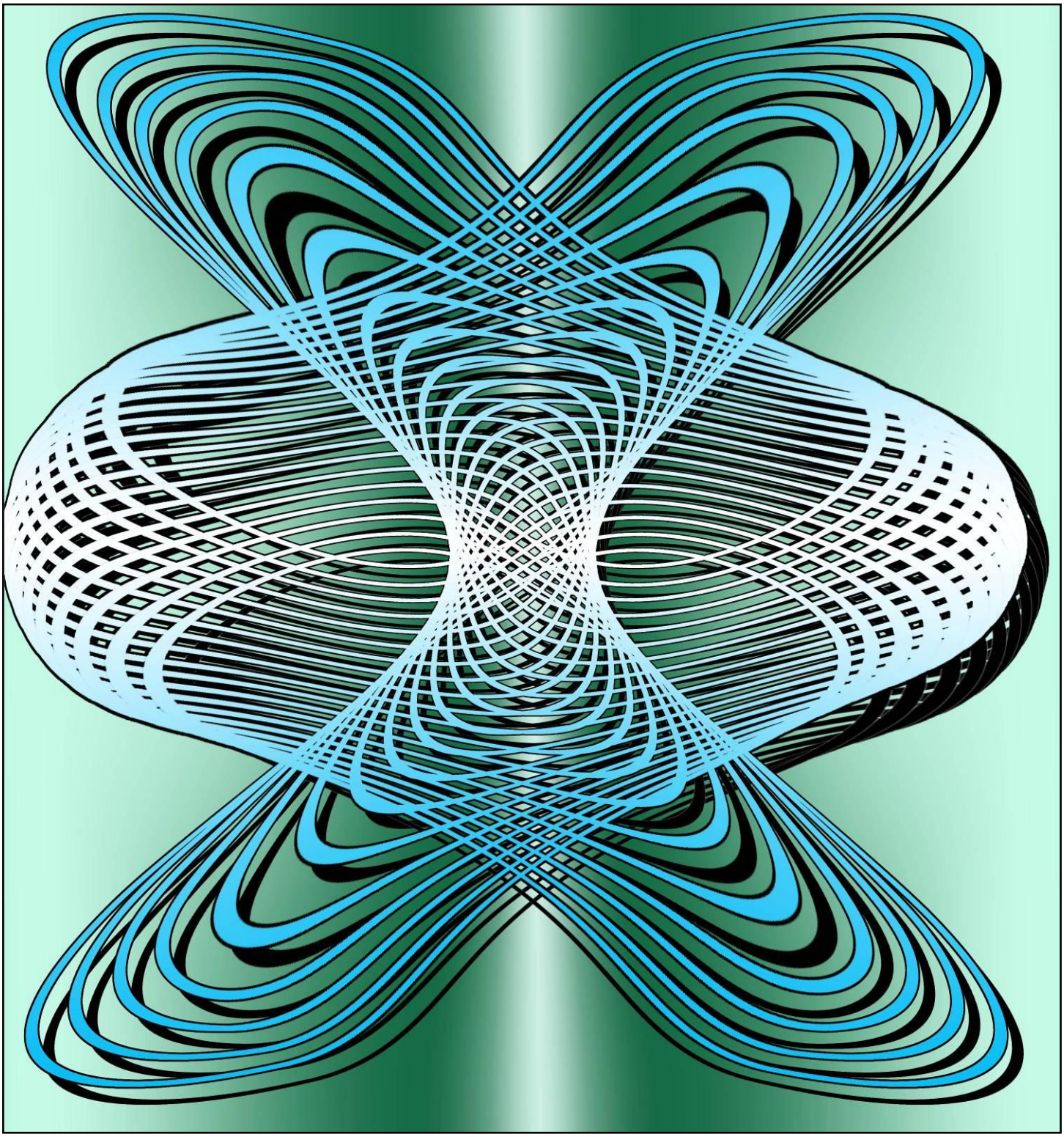


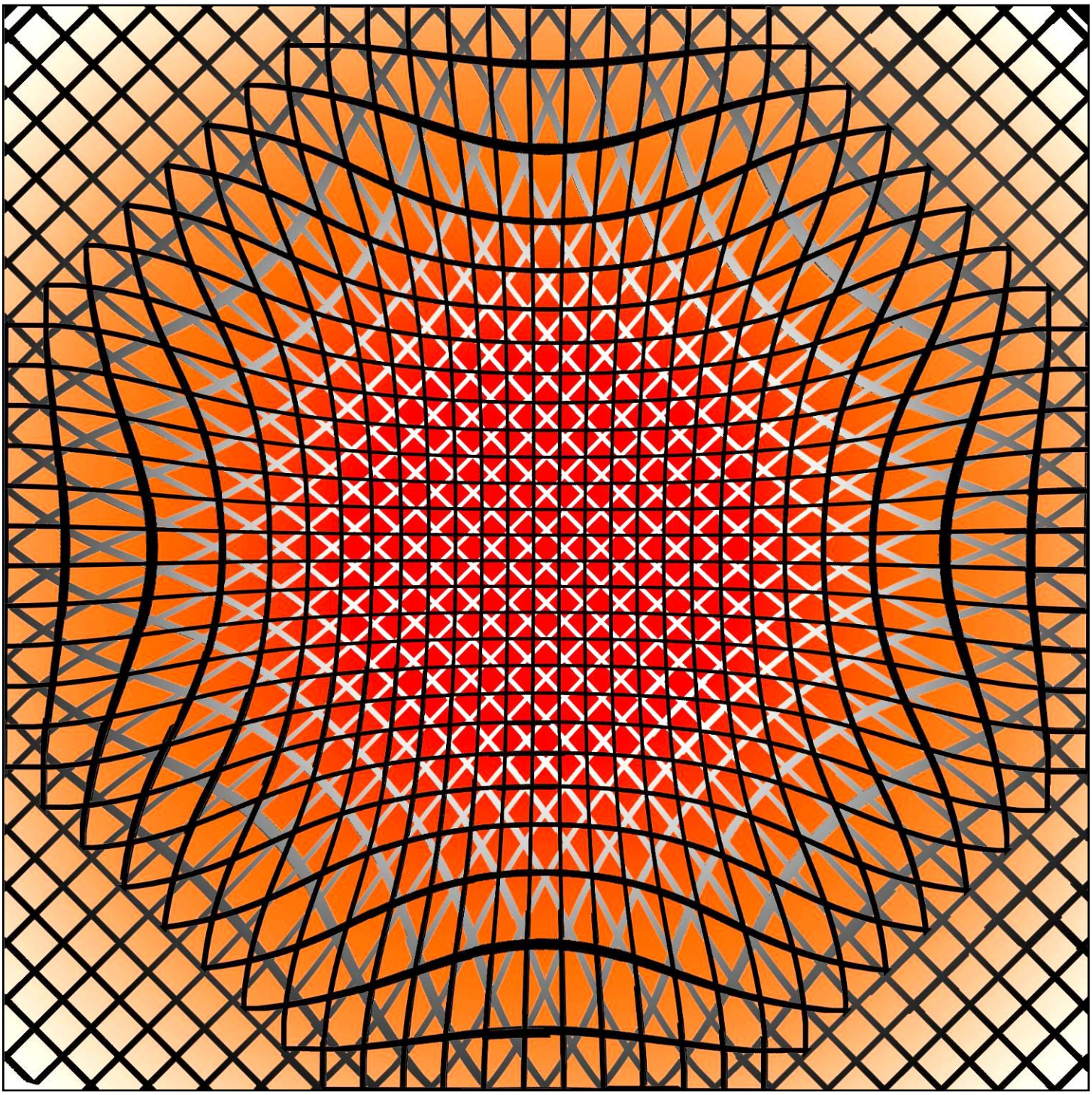


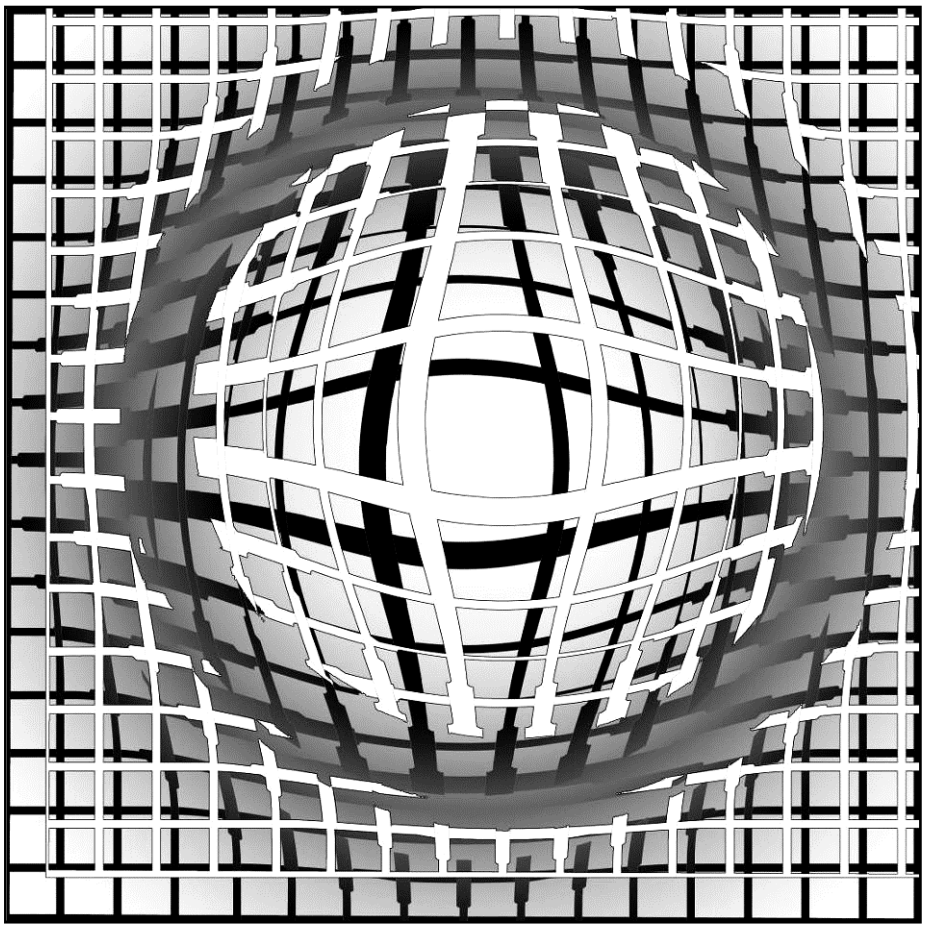


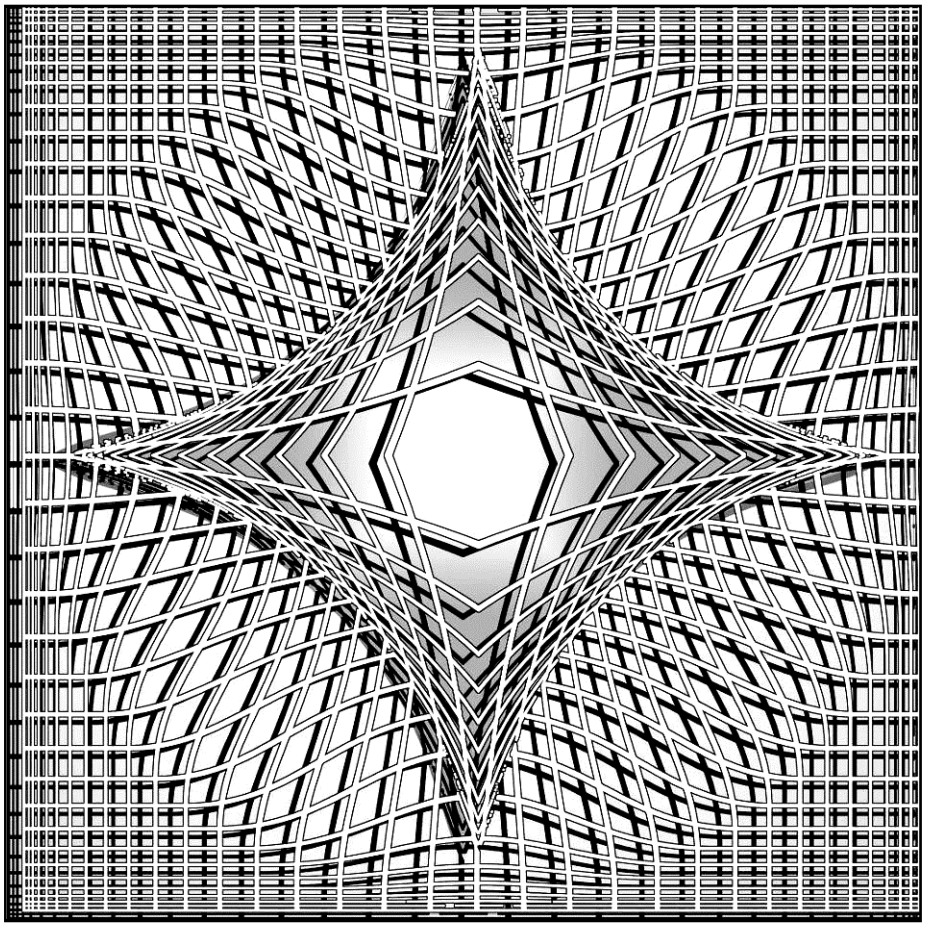




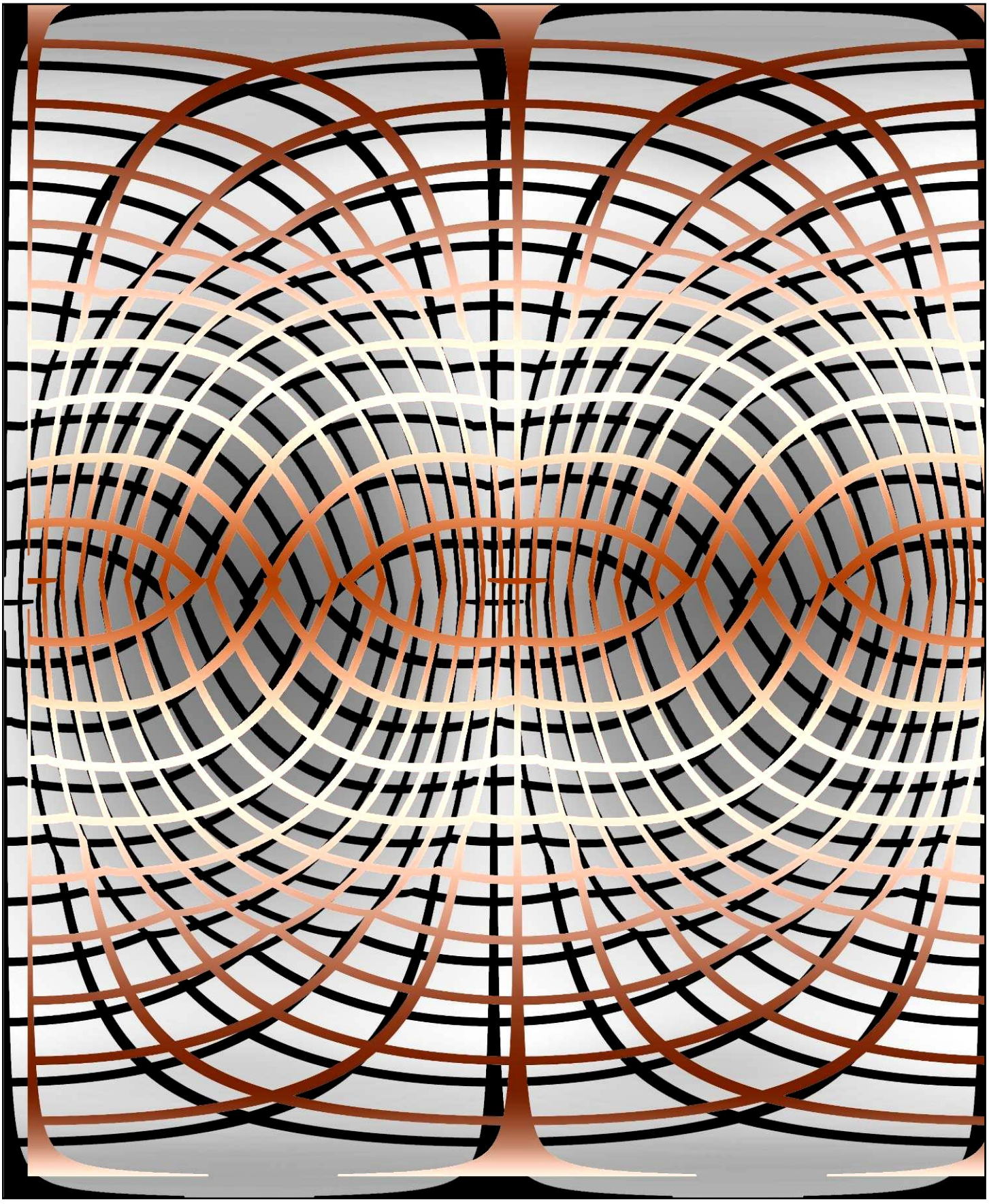


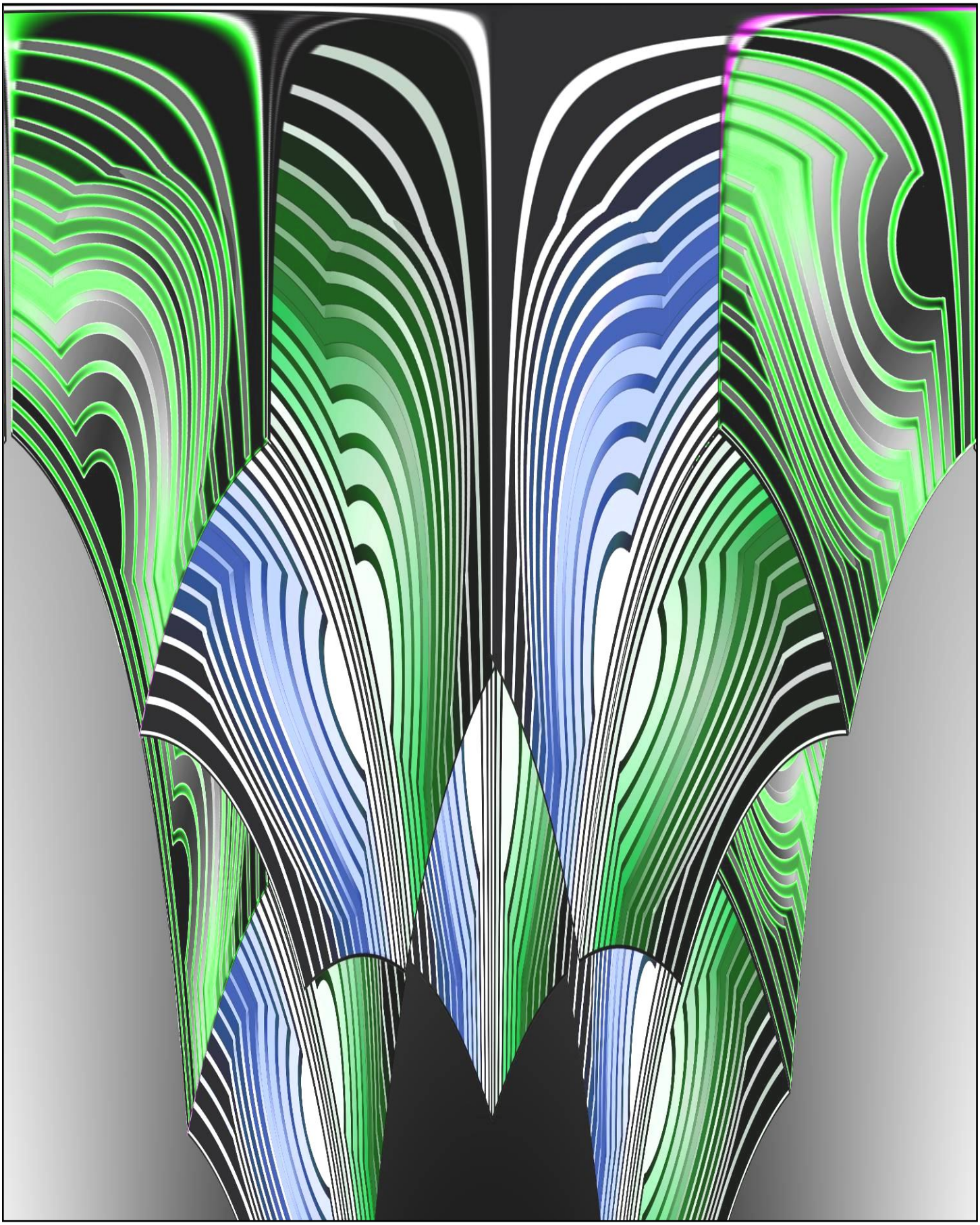


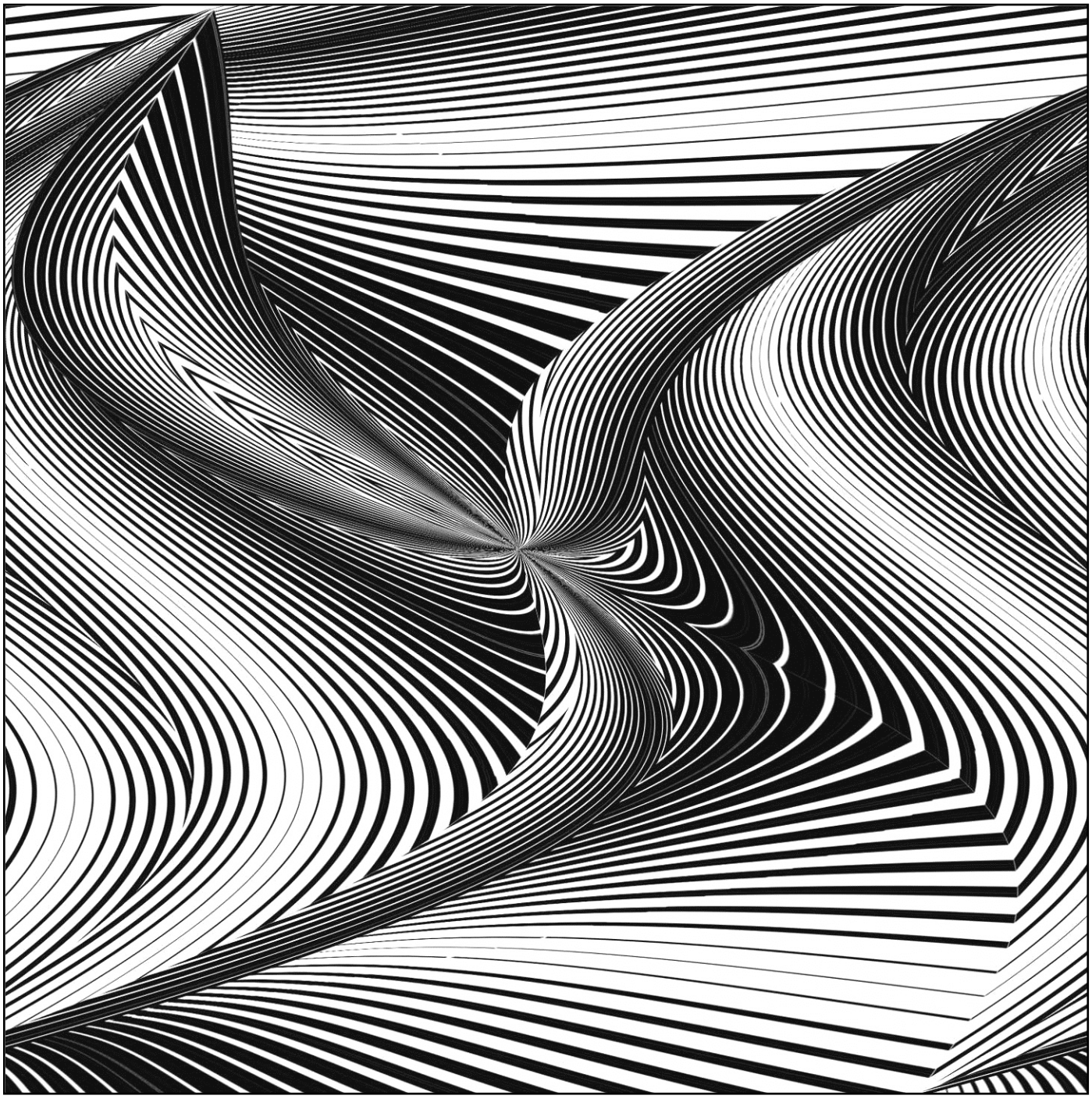


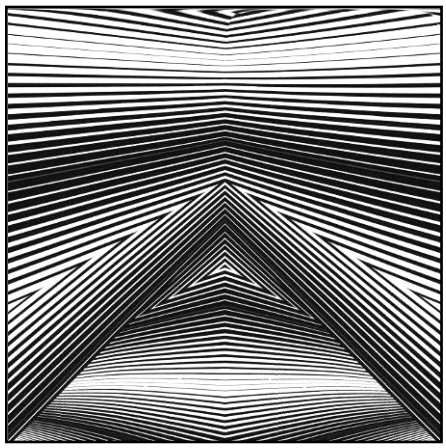


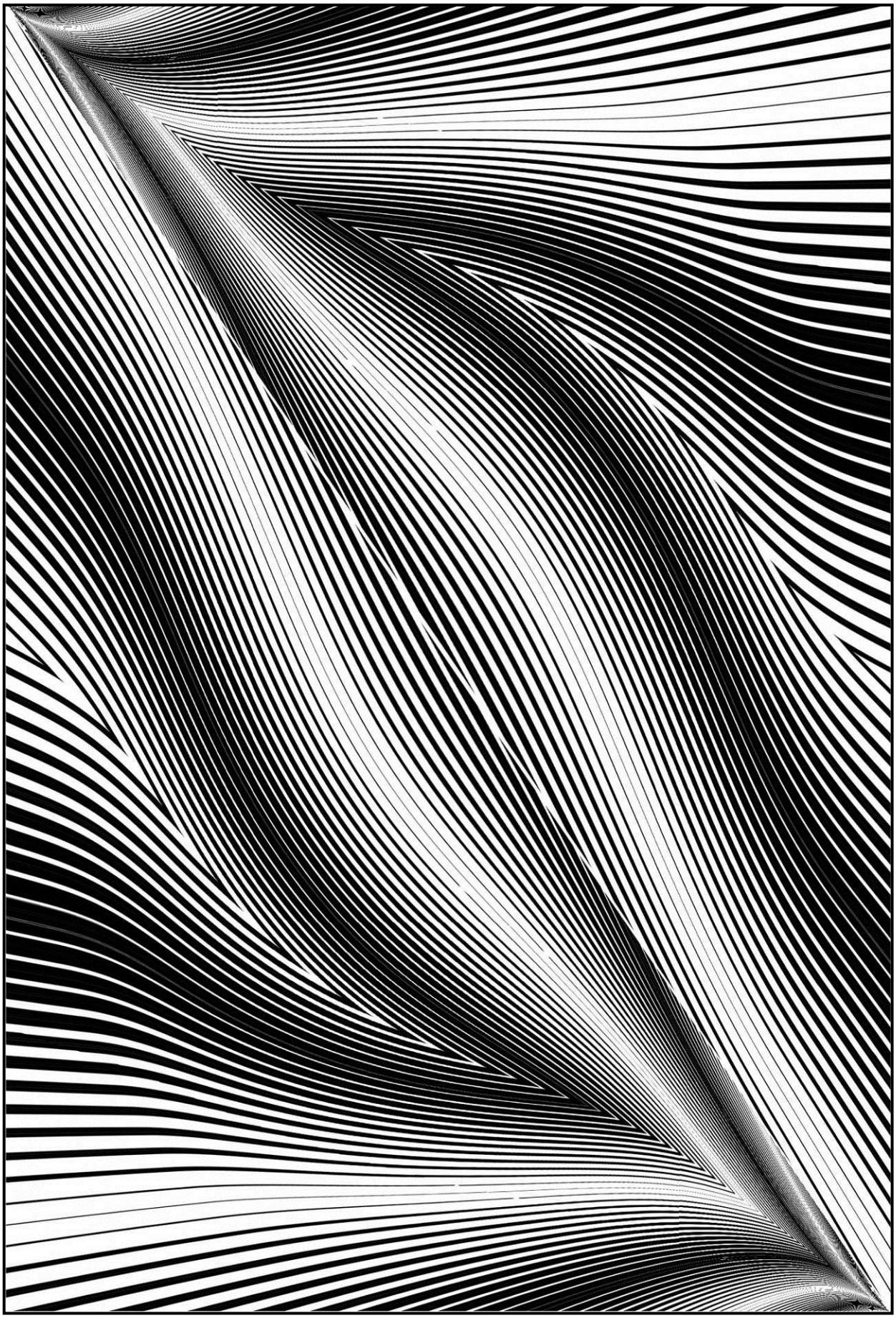
CONSTRUCTION

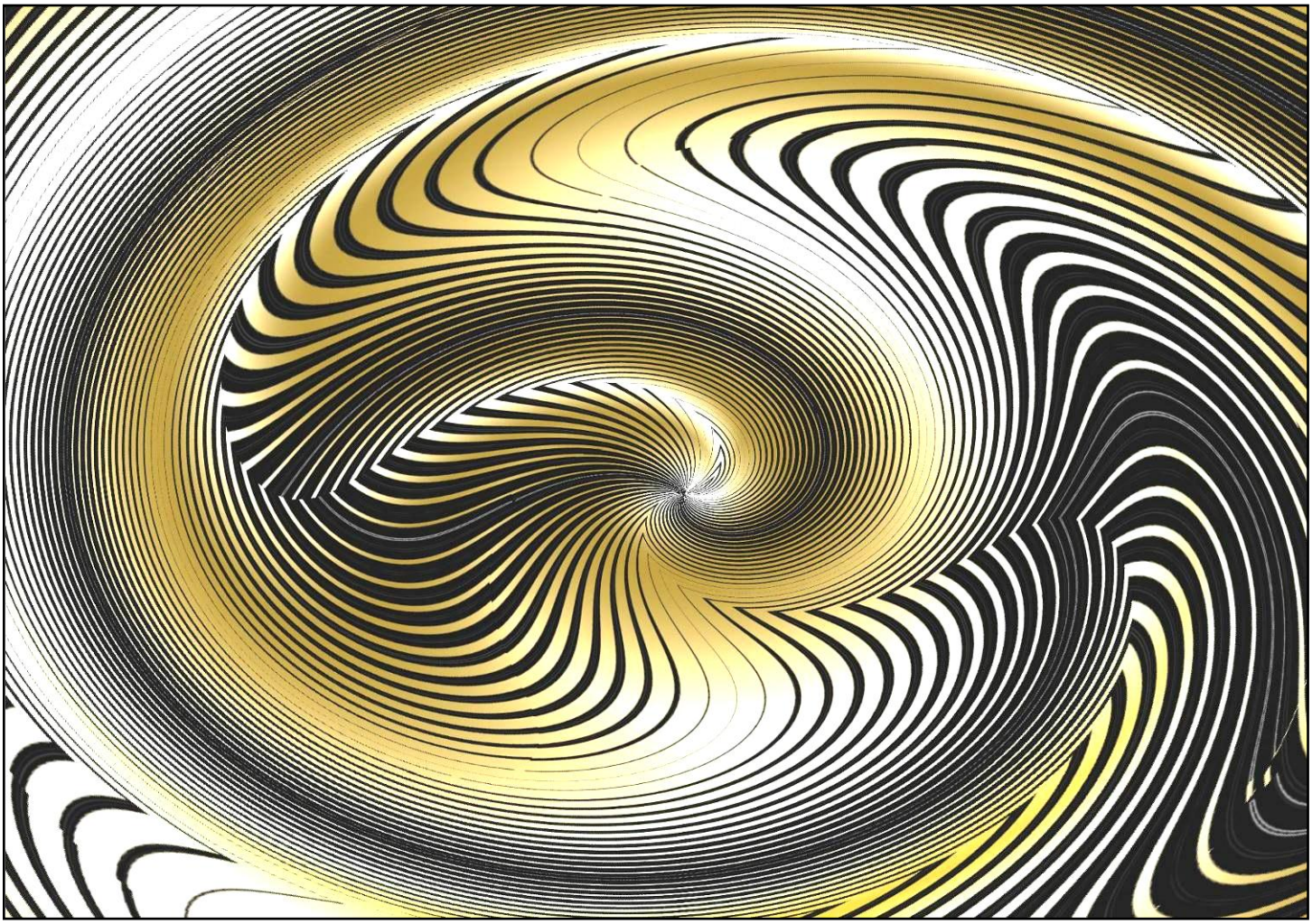


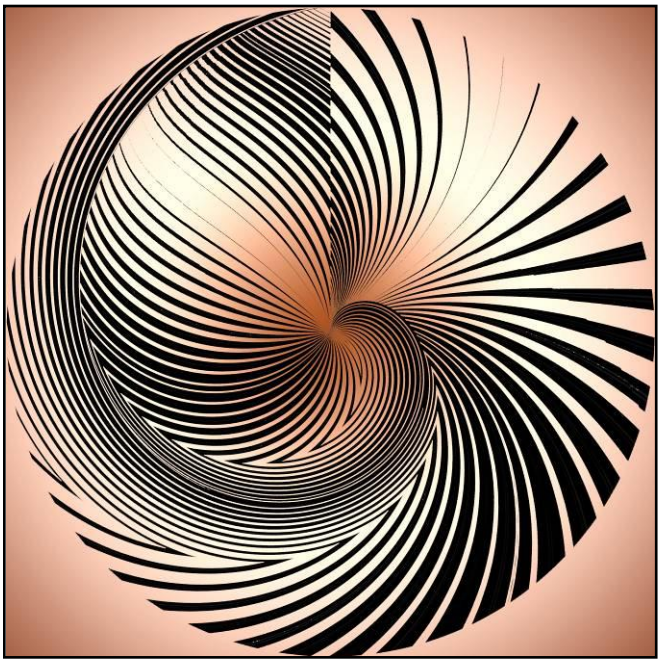


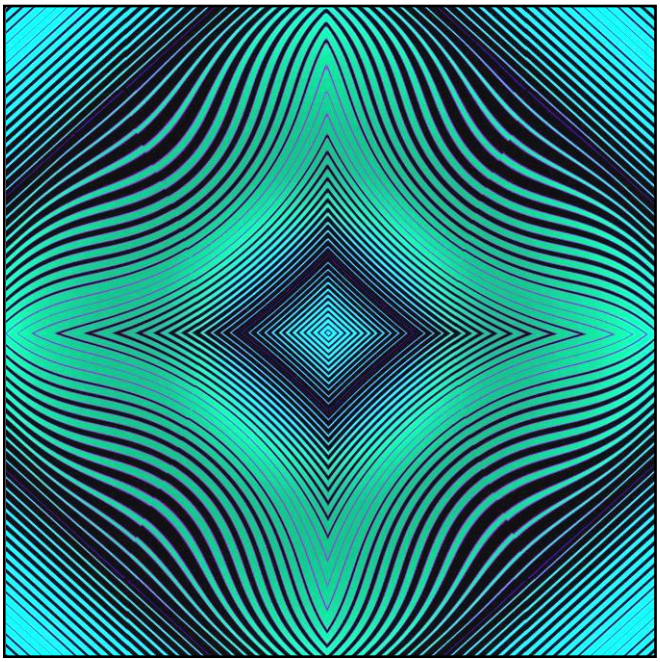


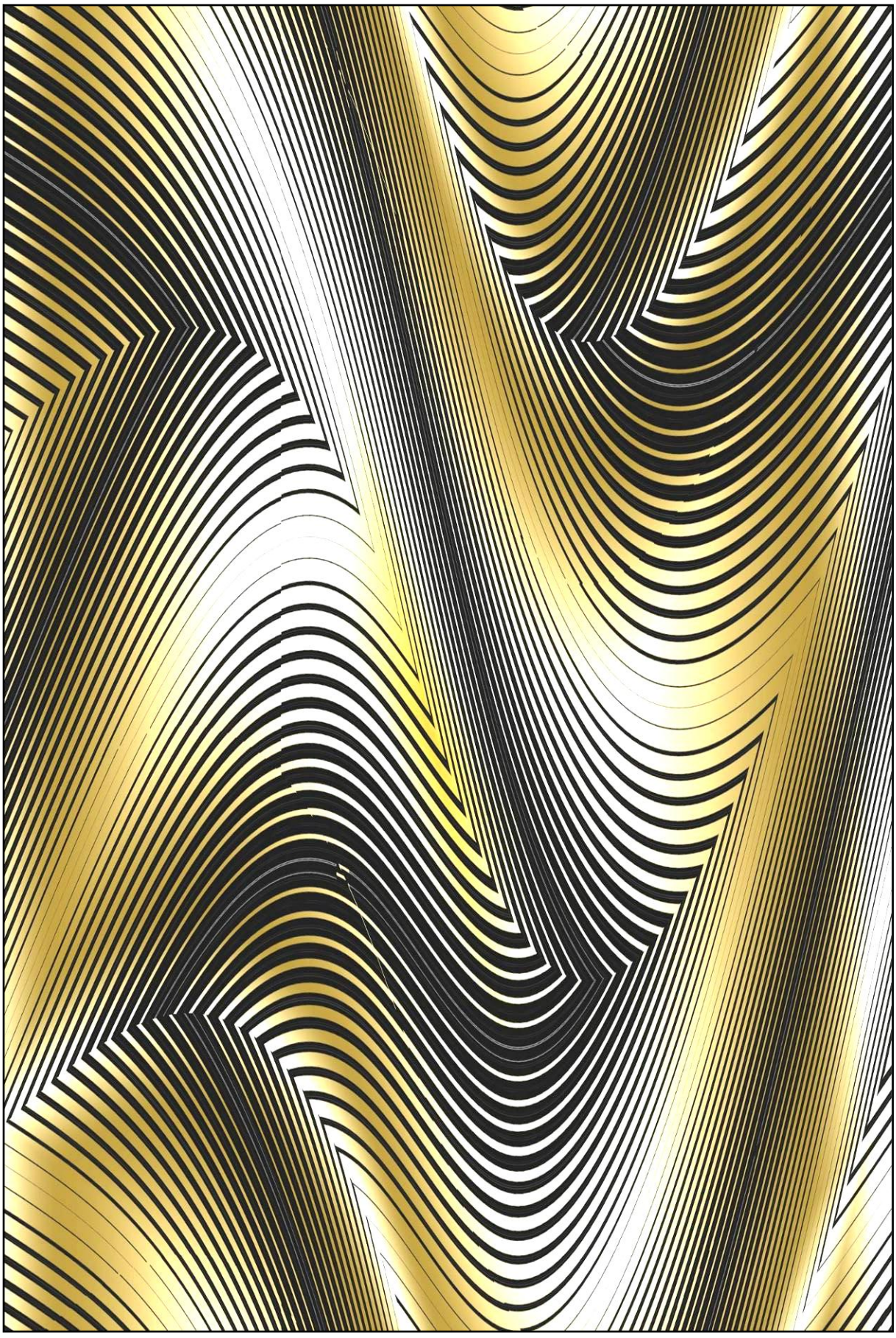


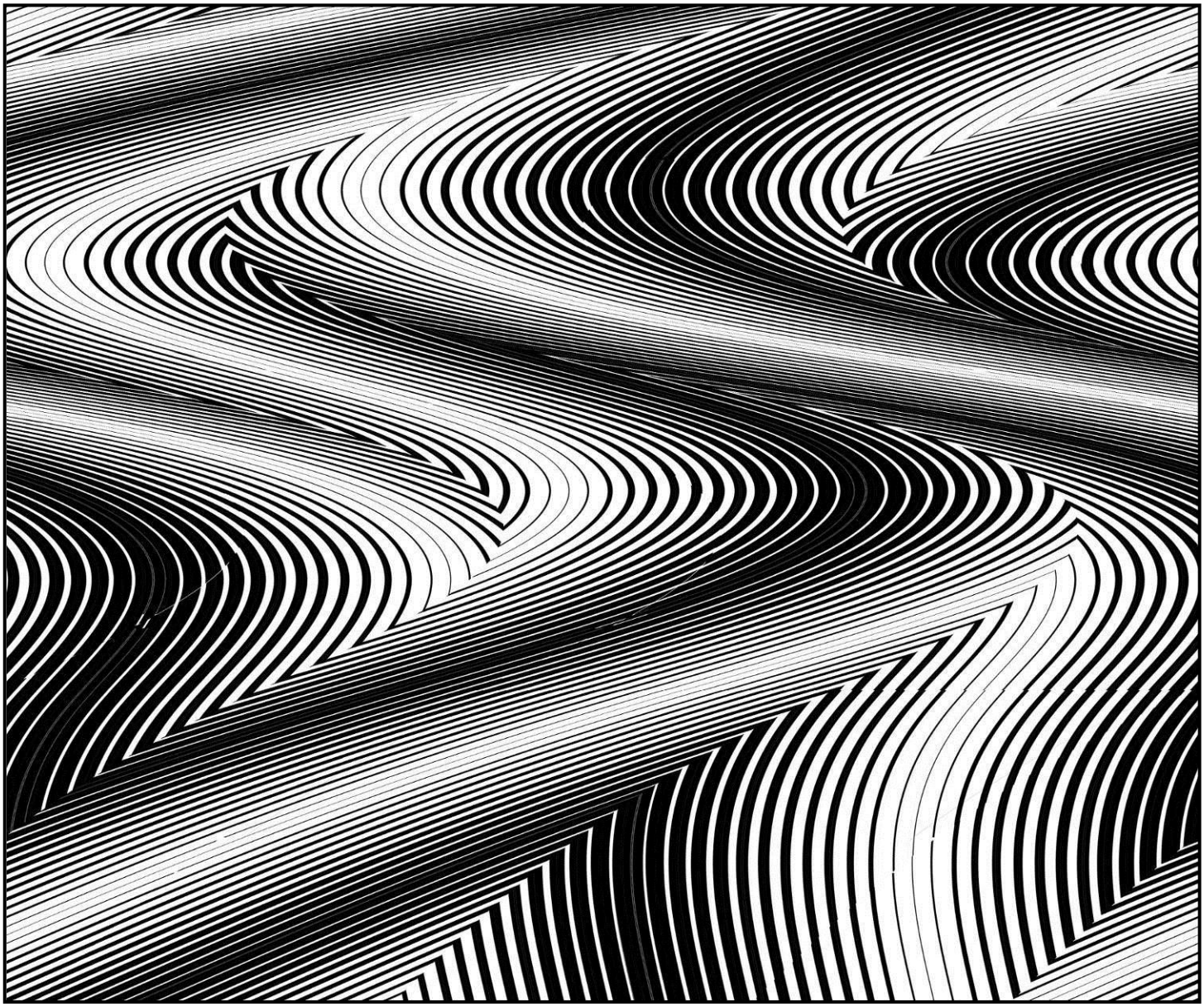


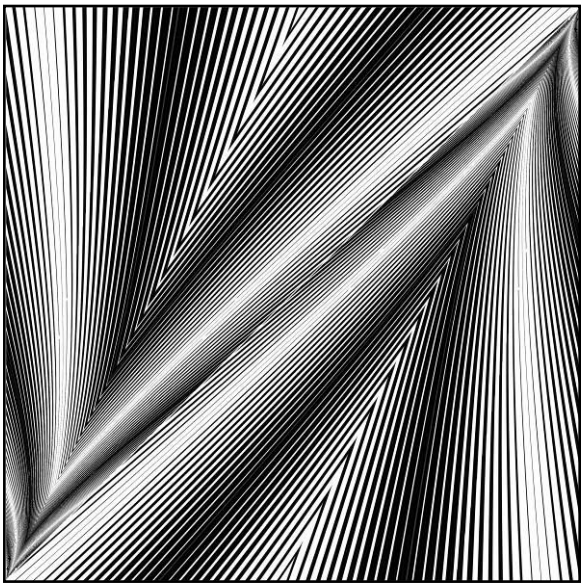


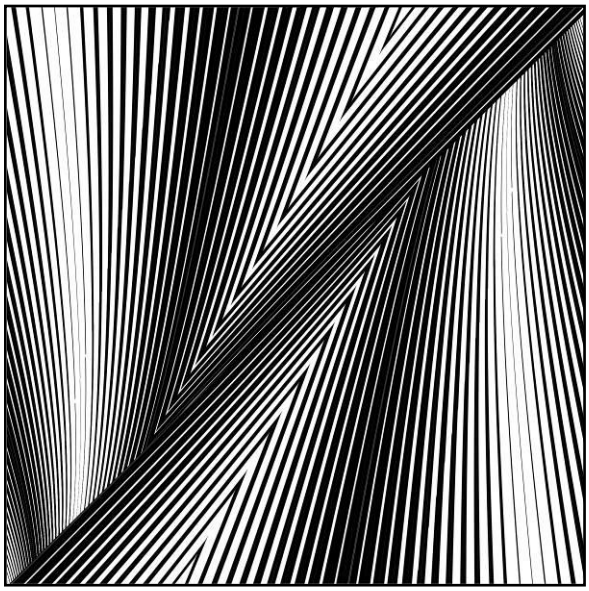


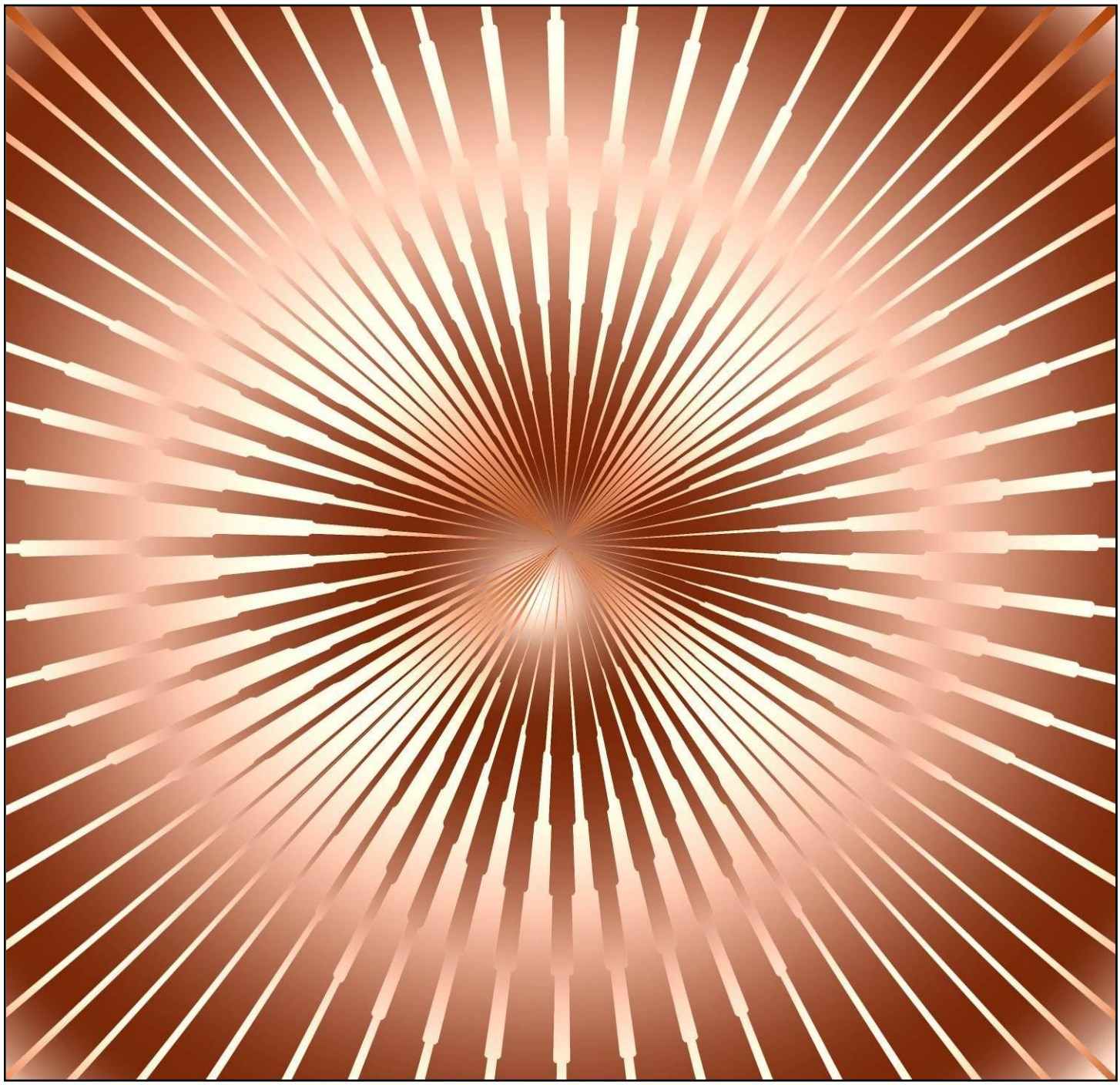


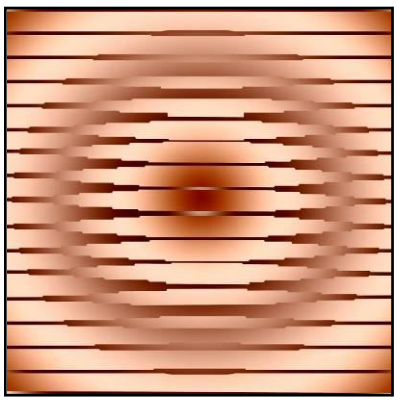


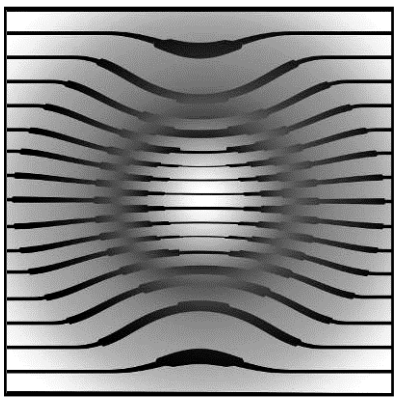


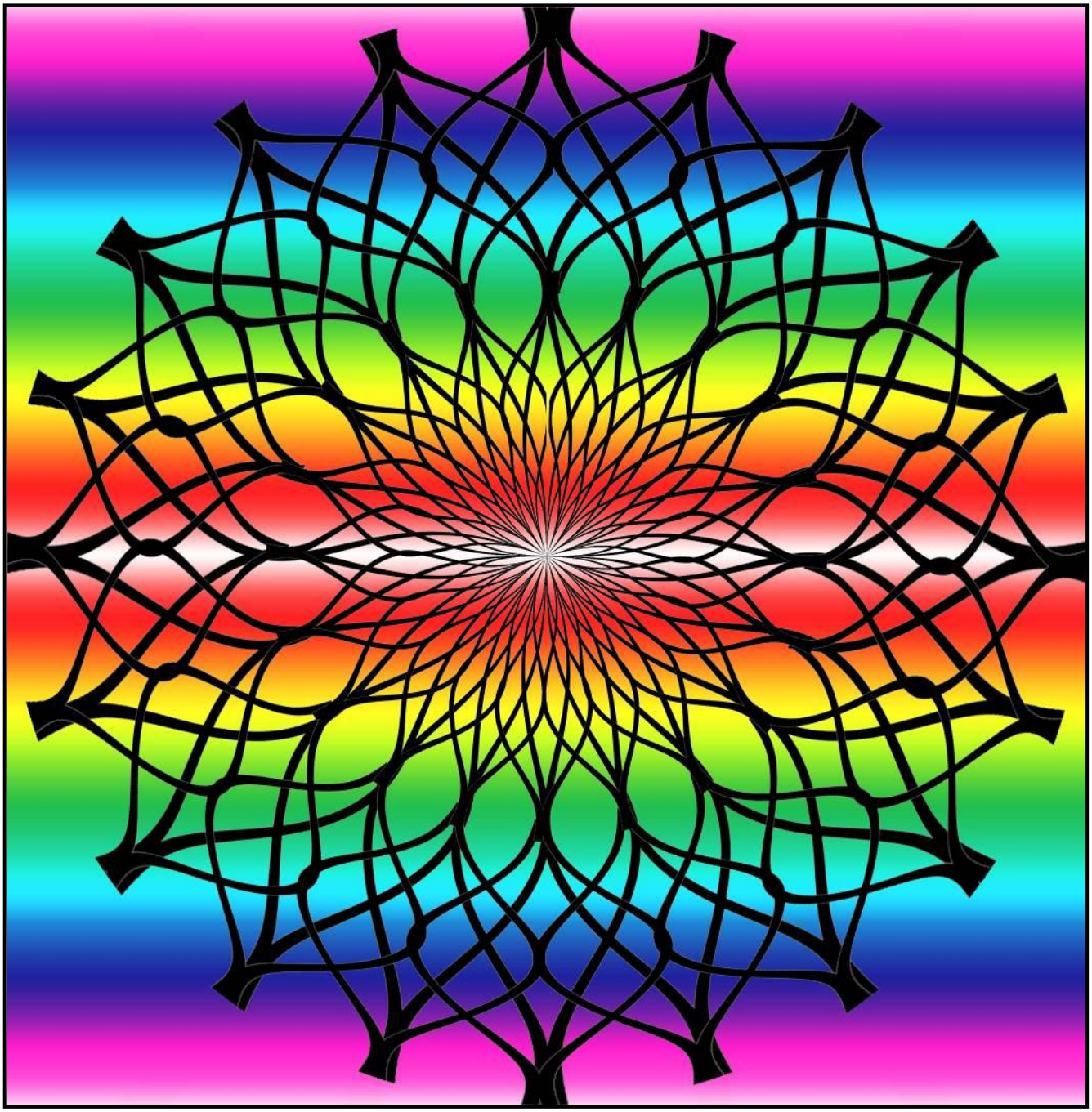


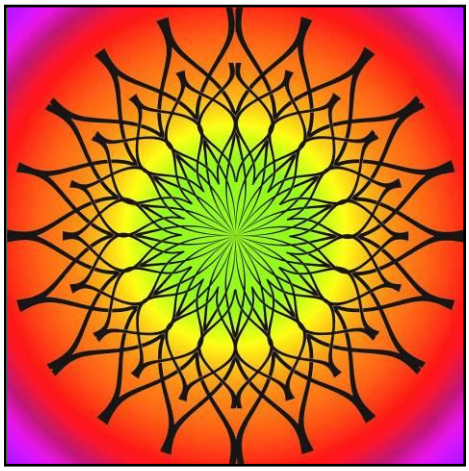


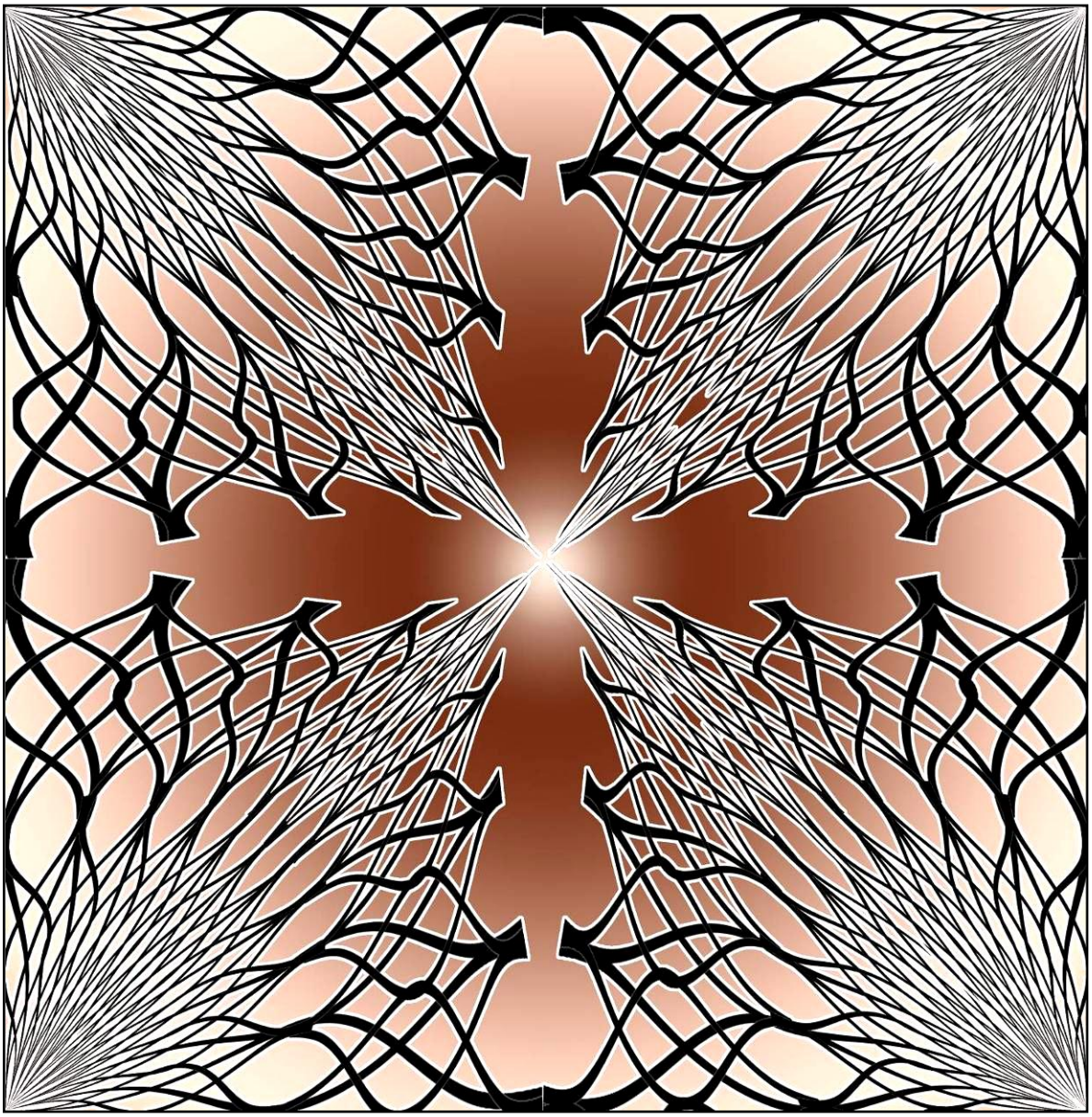


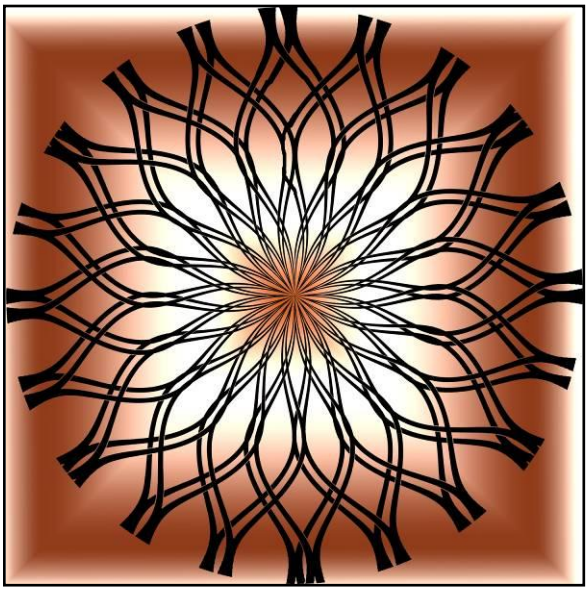


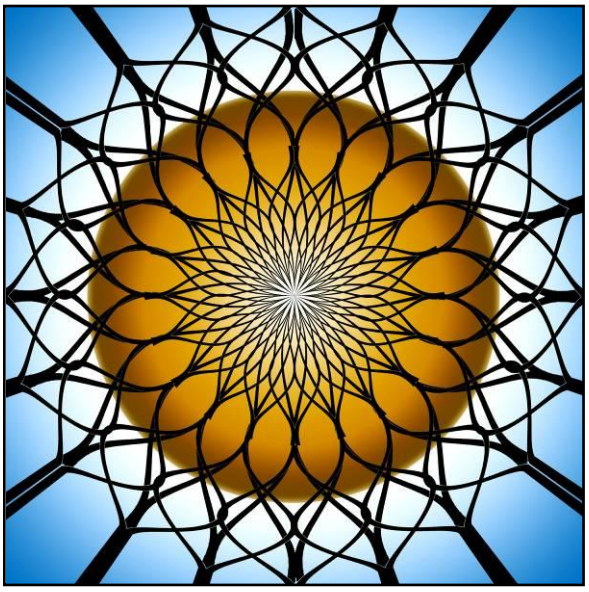


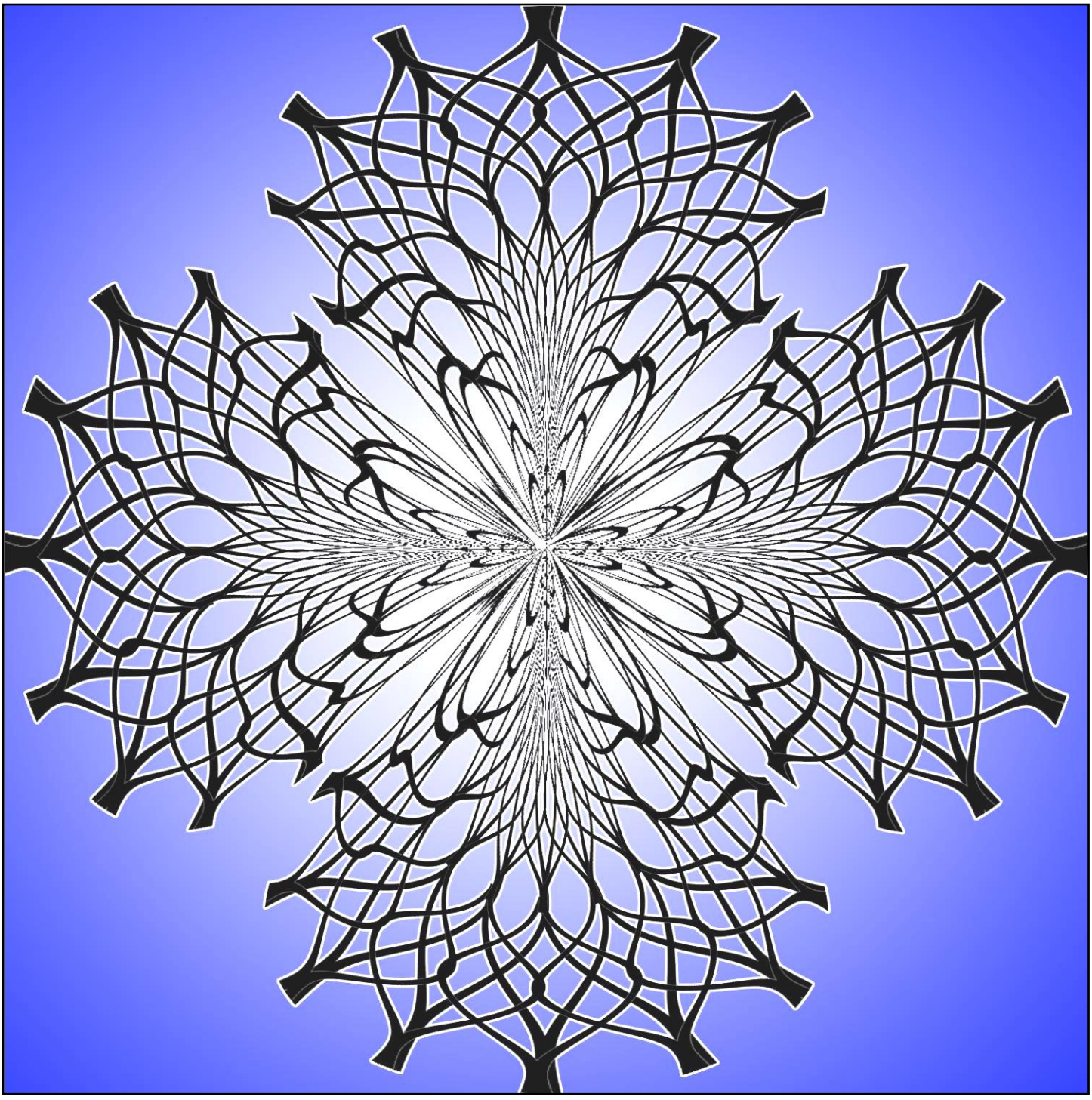


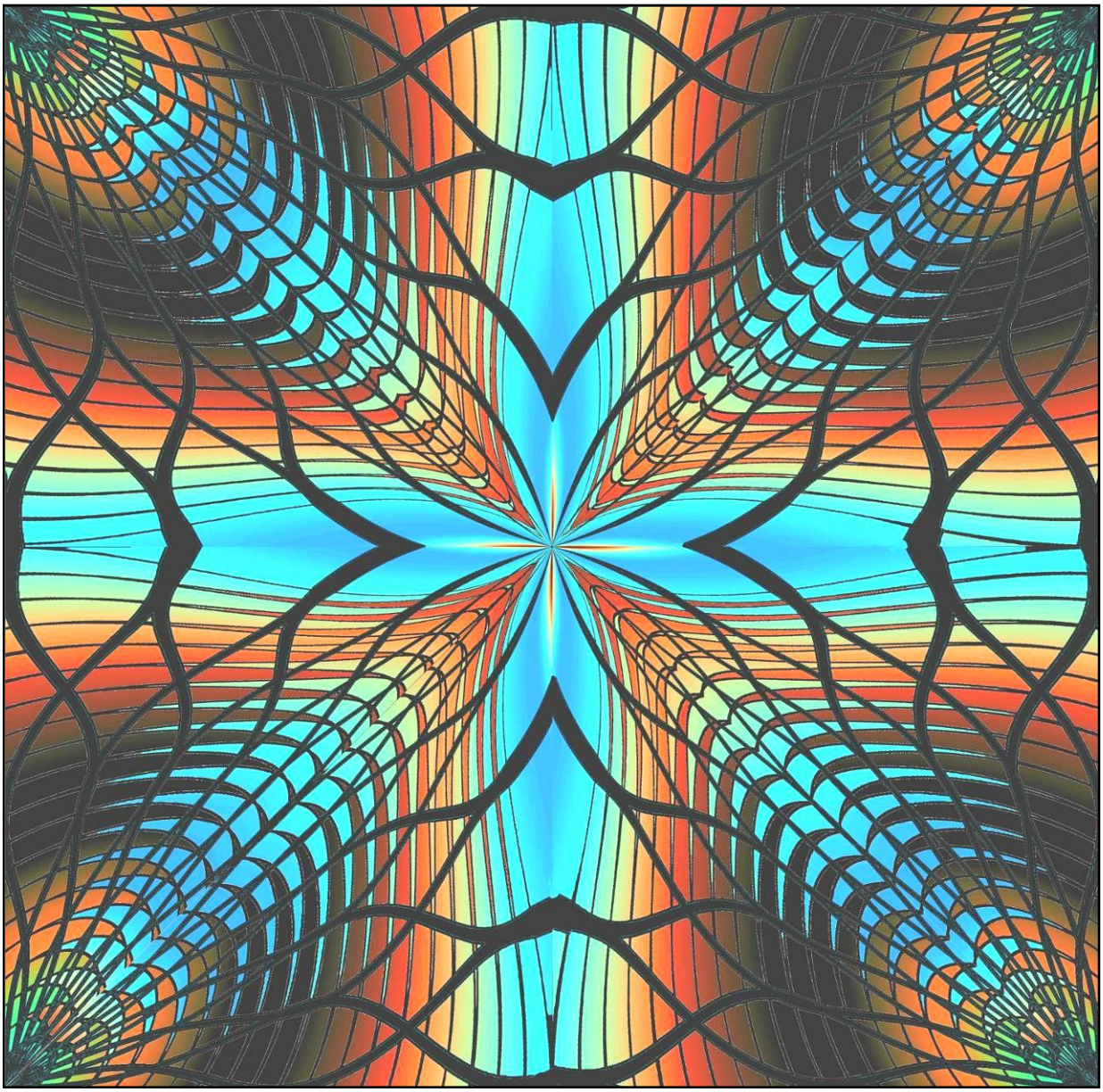


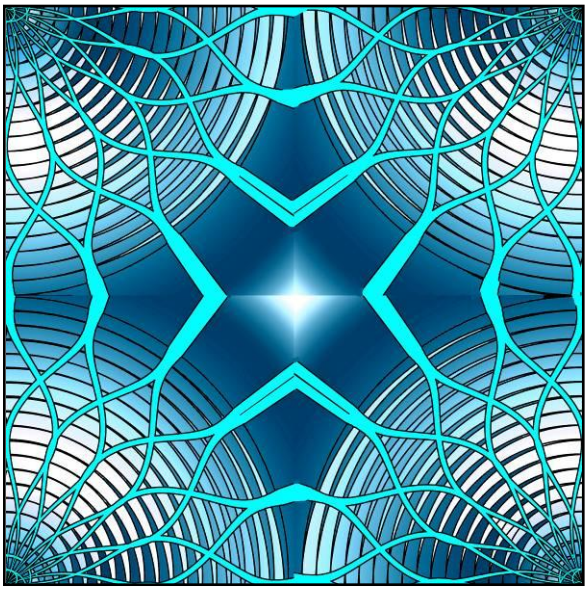


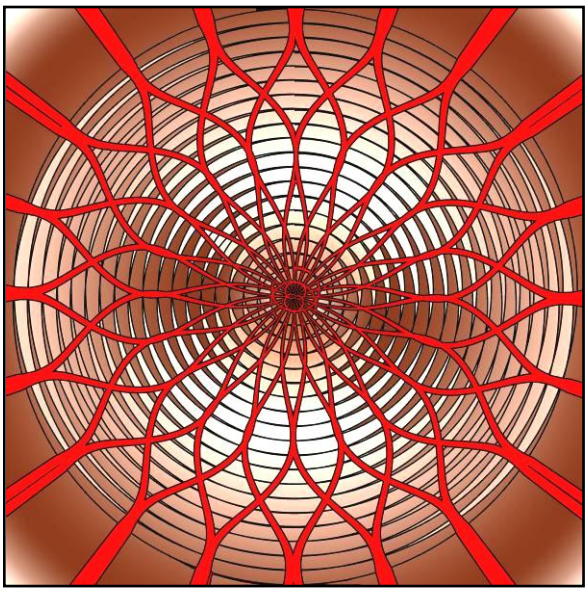


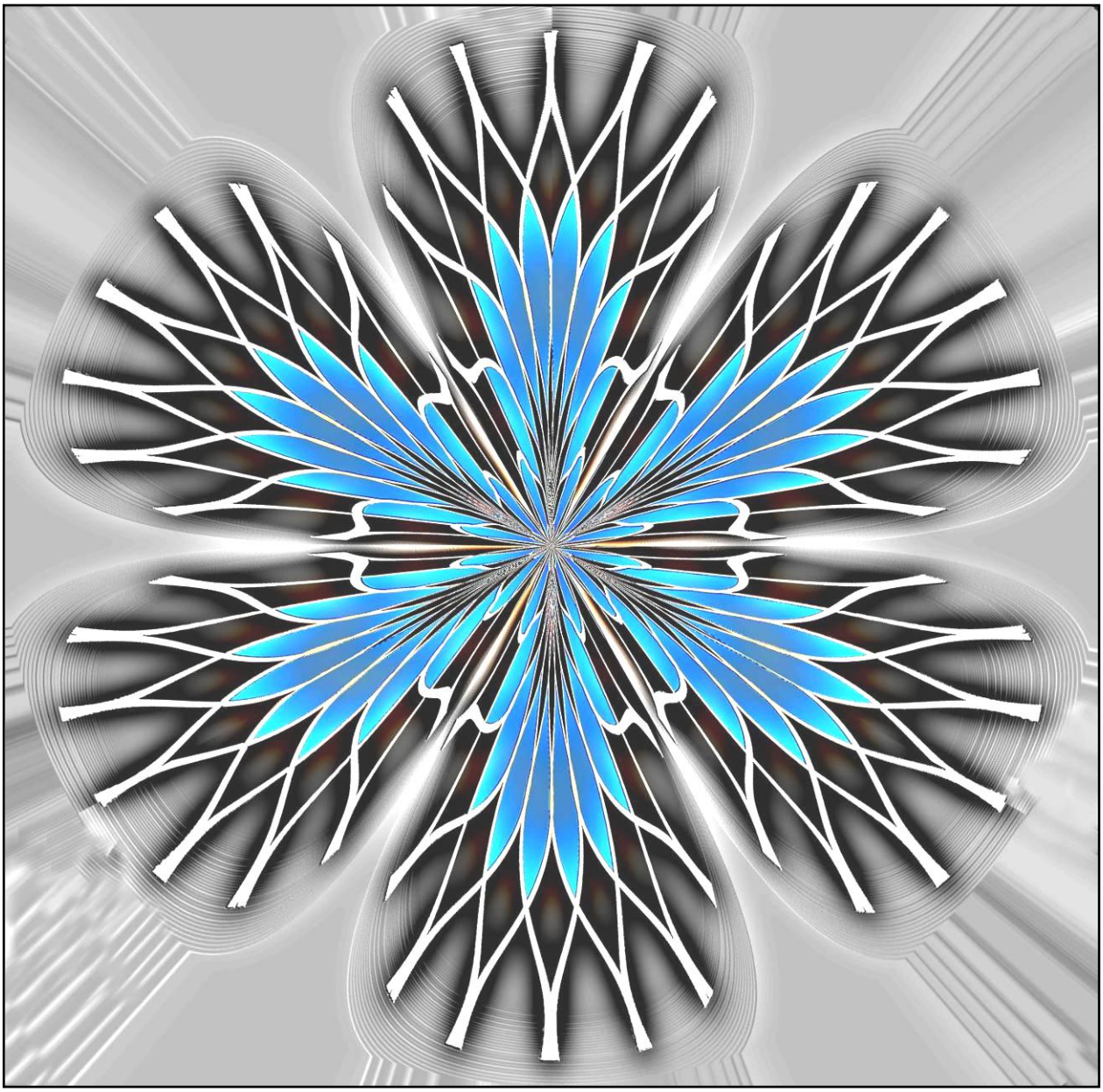


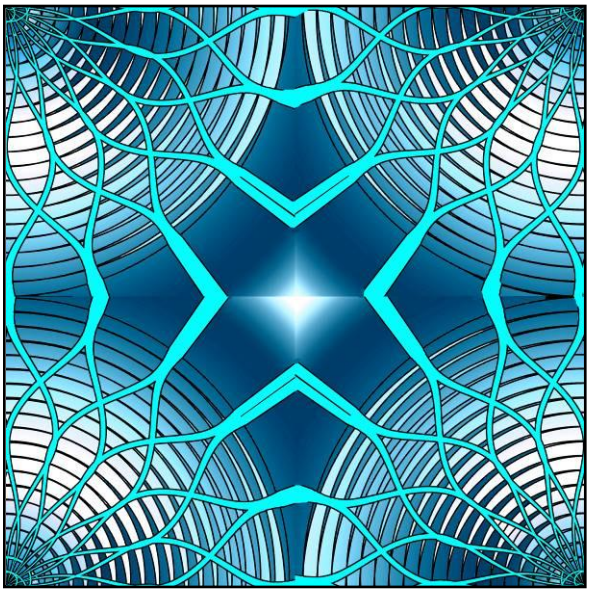


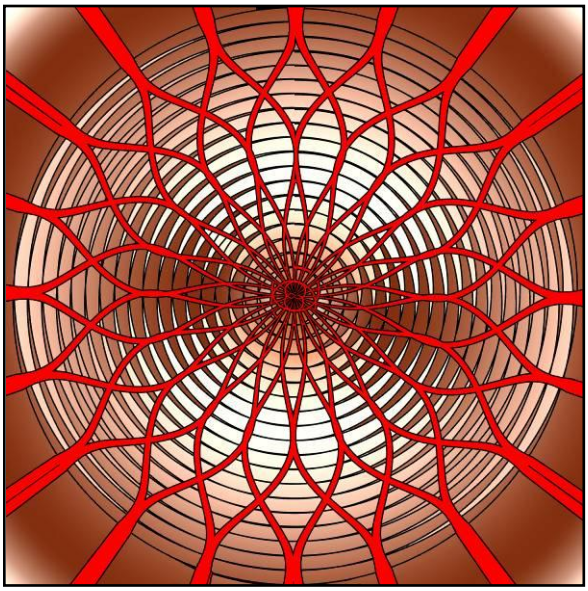


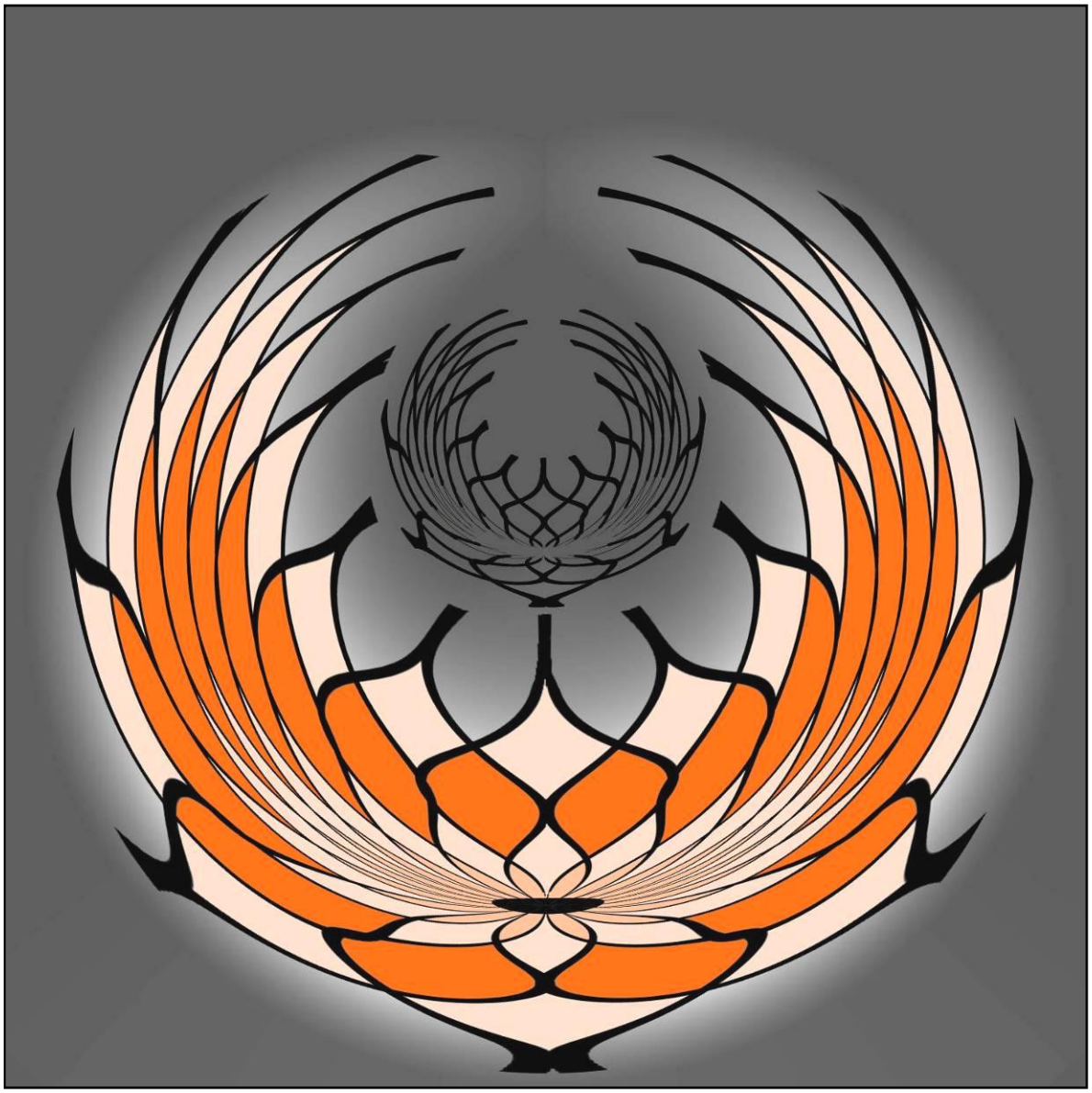


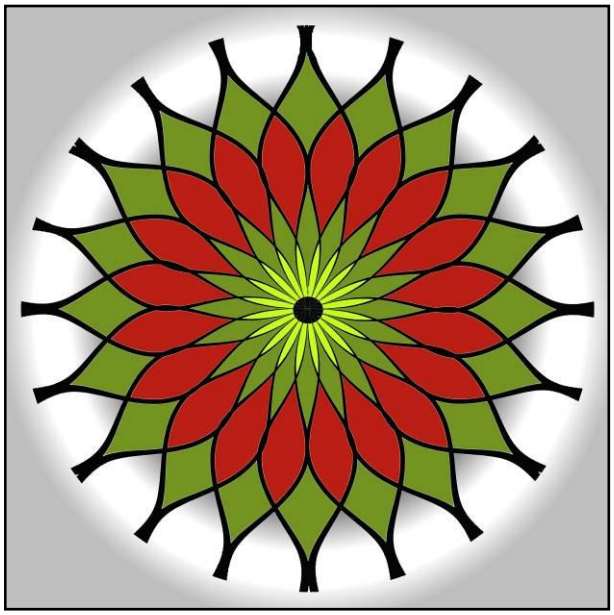


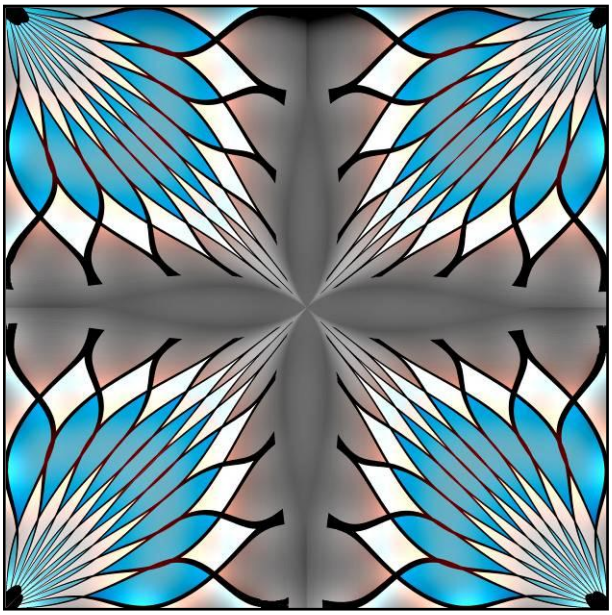


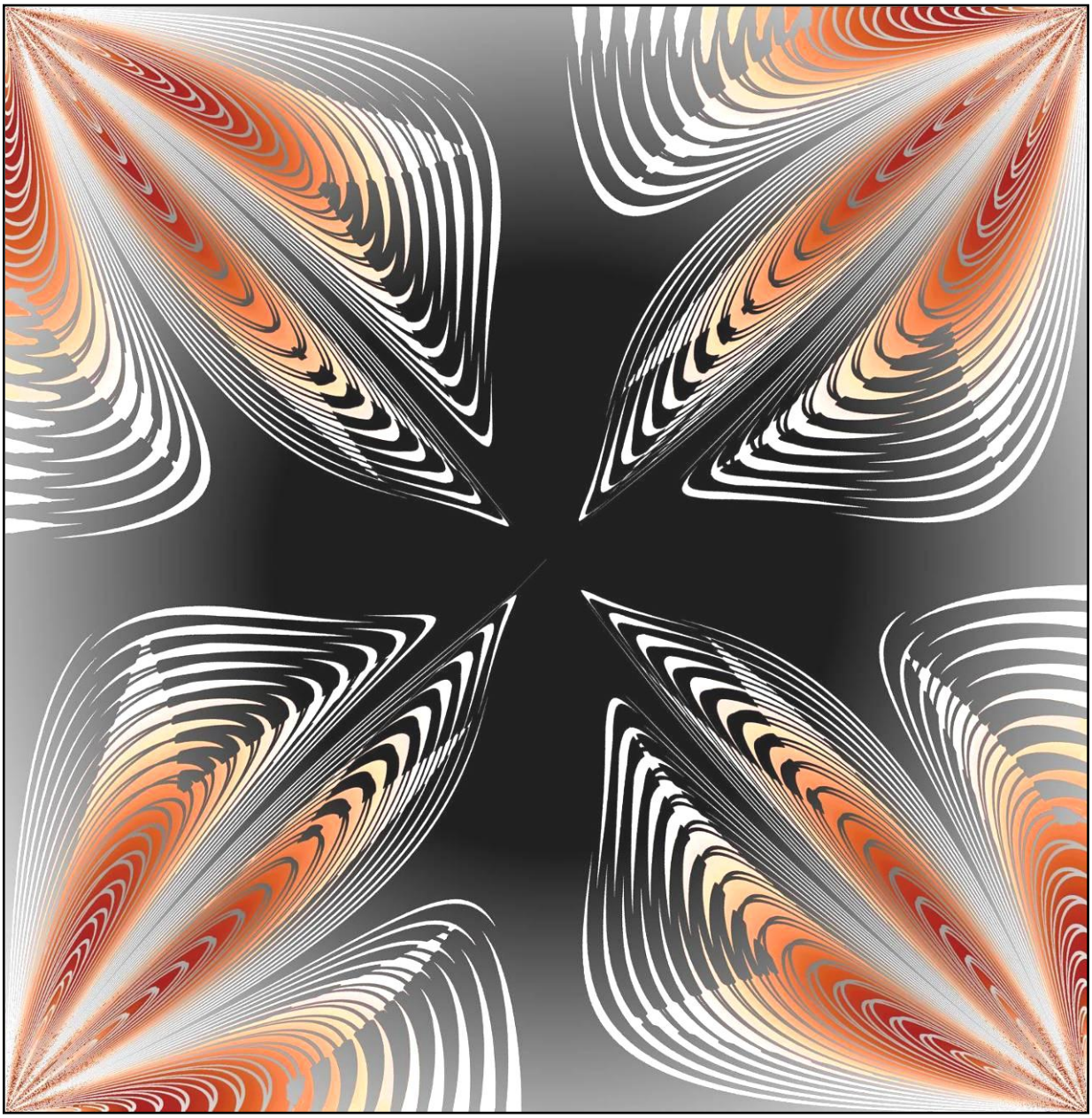


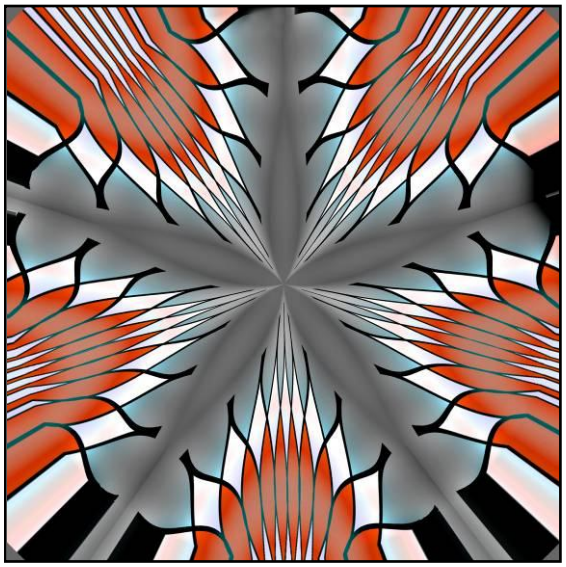


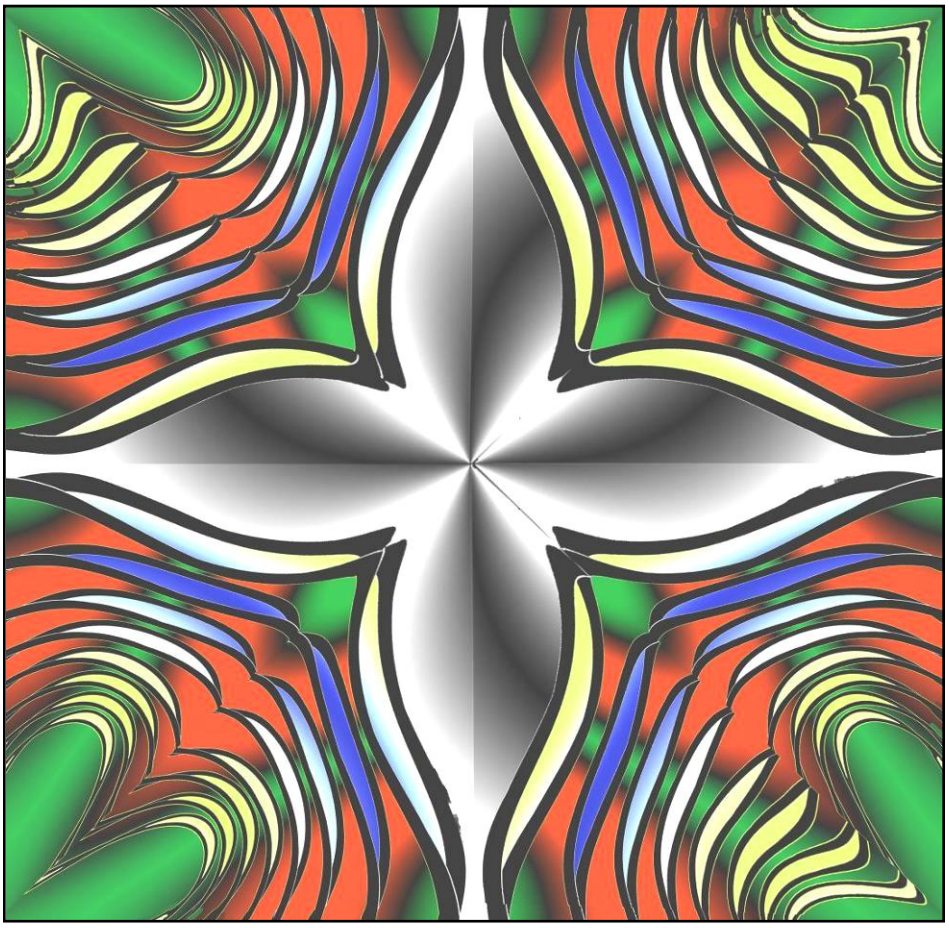


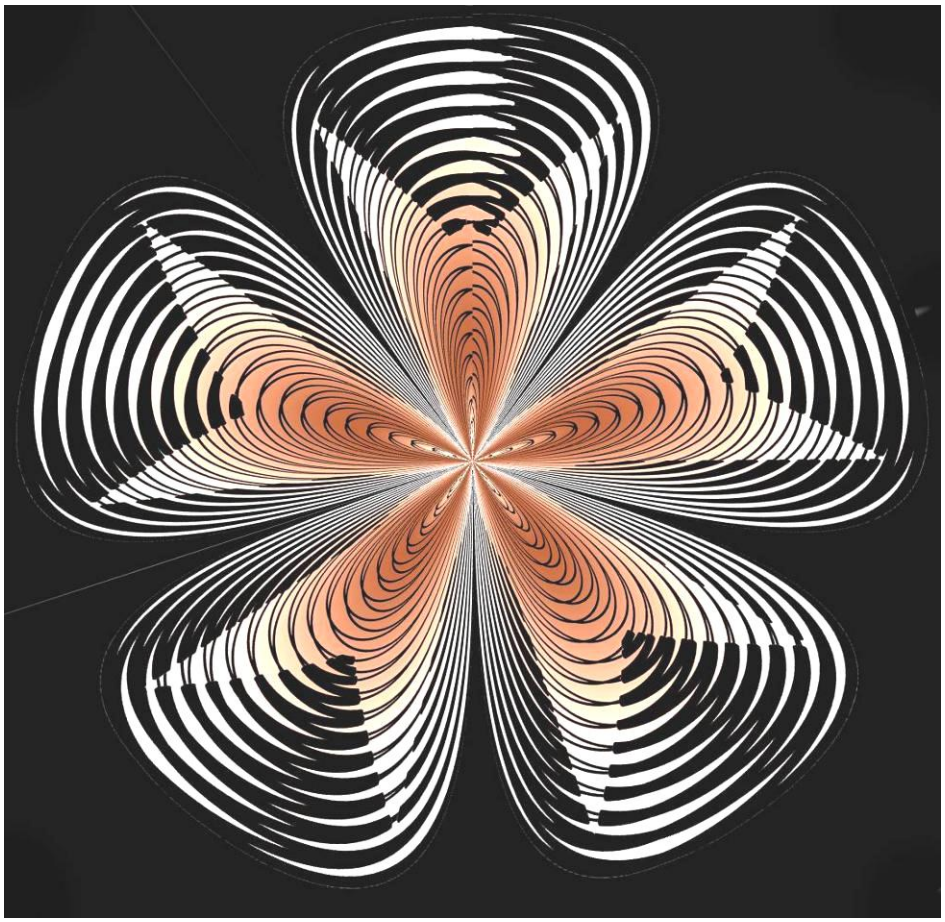


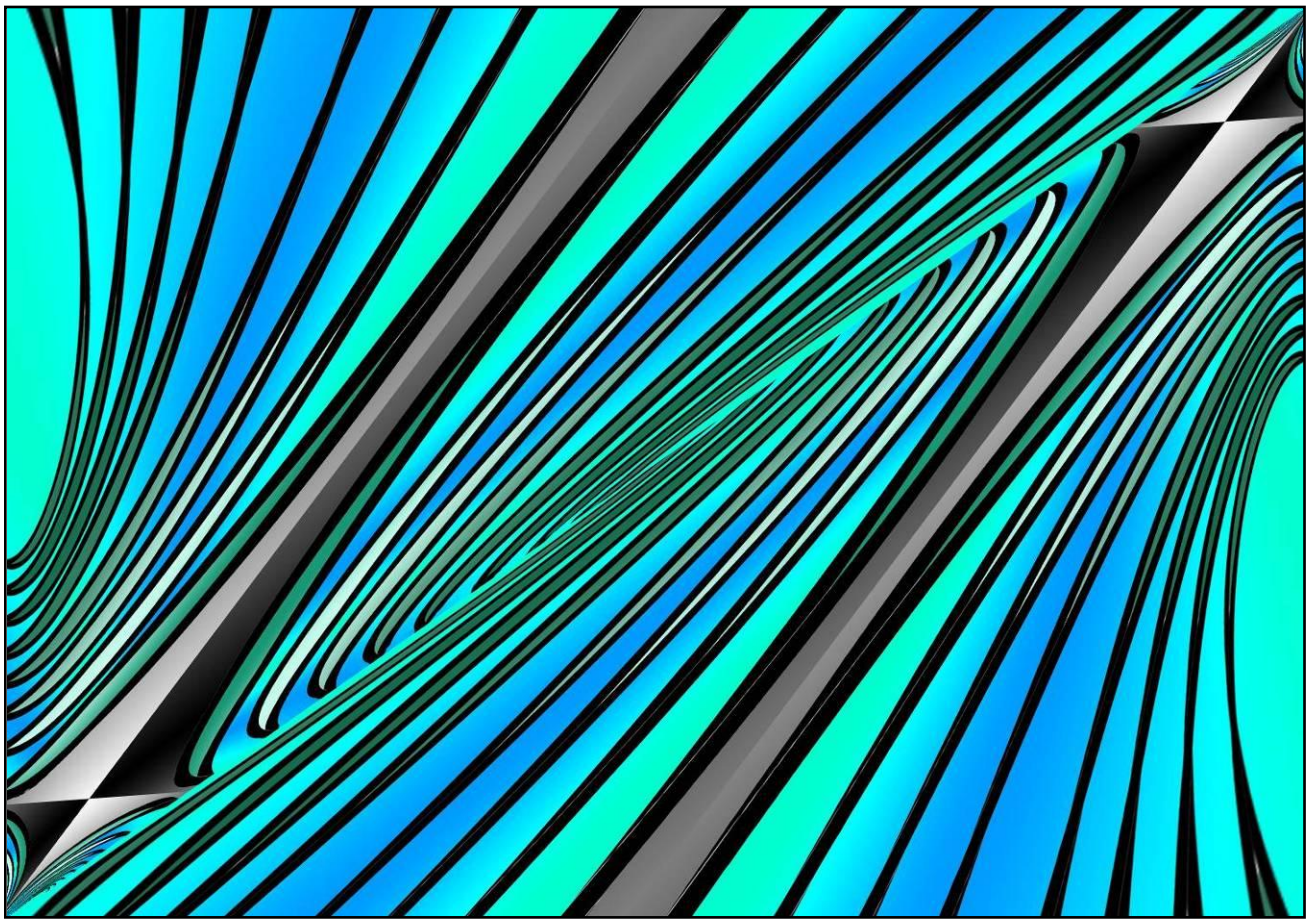


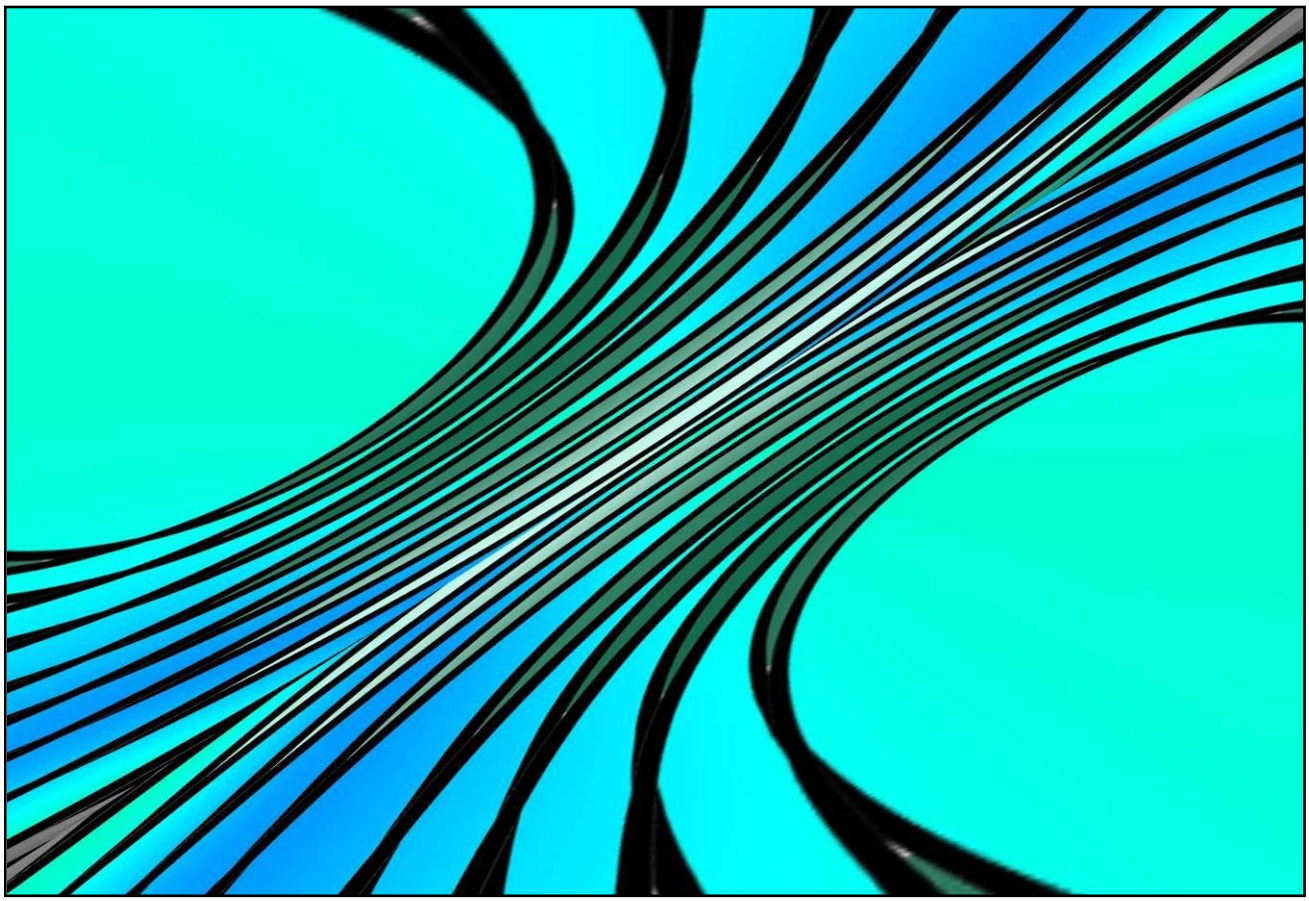


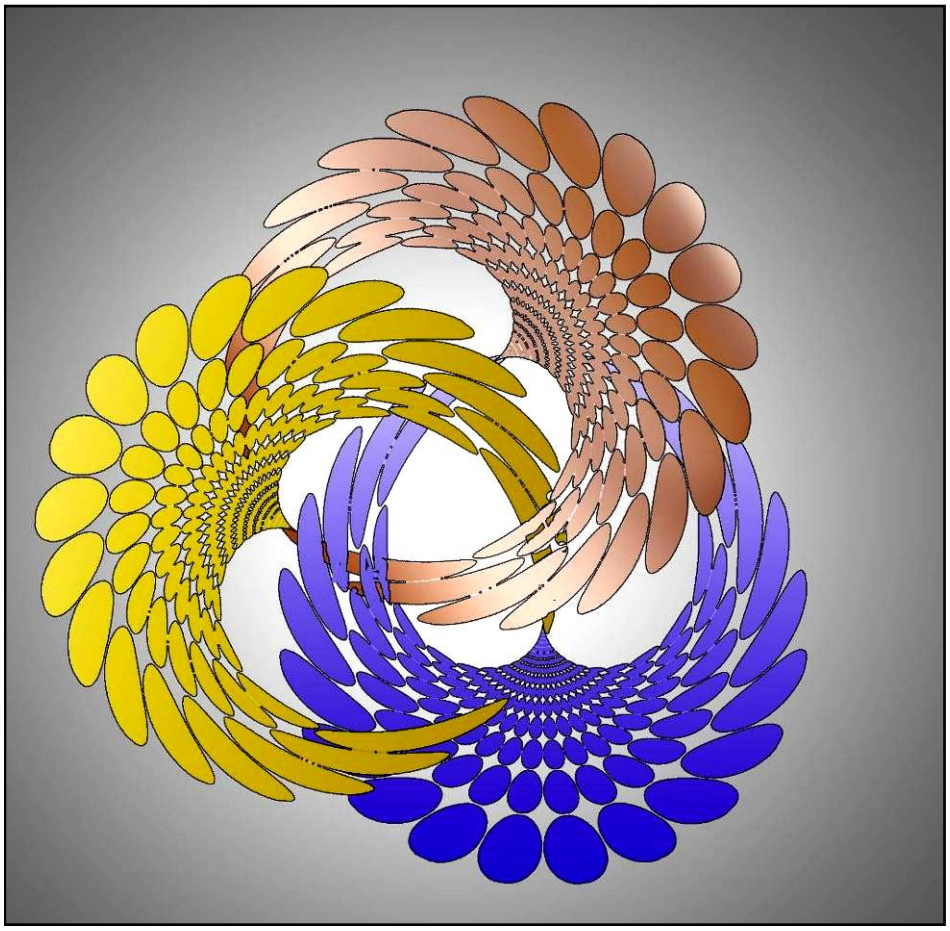


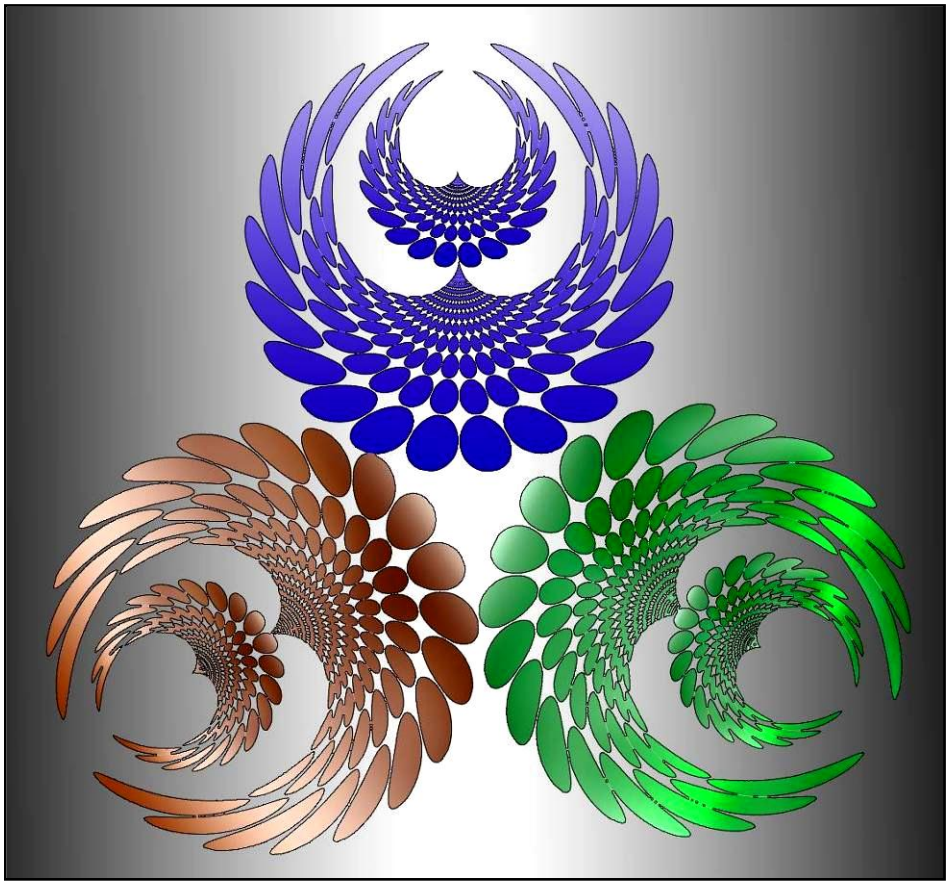


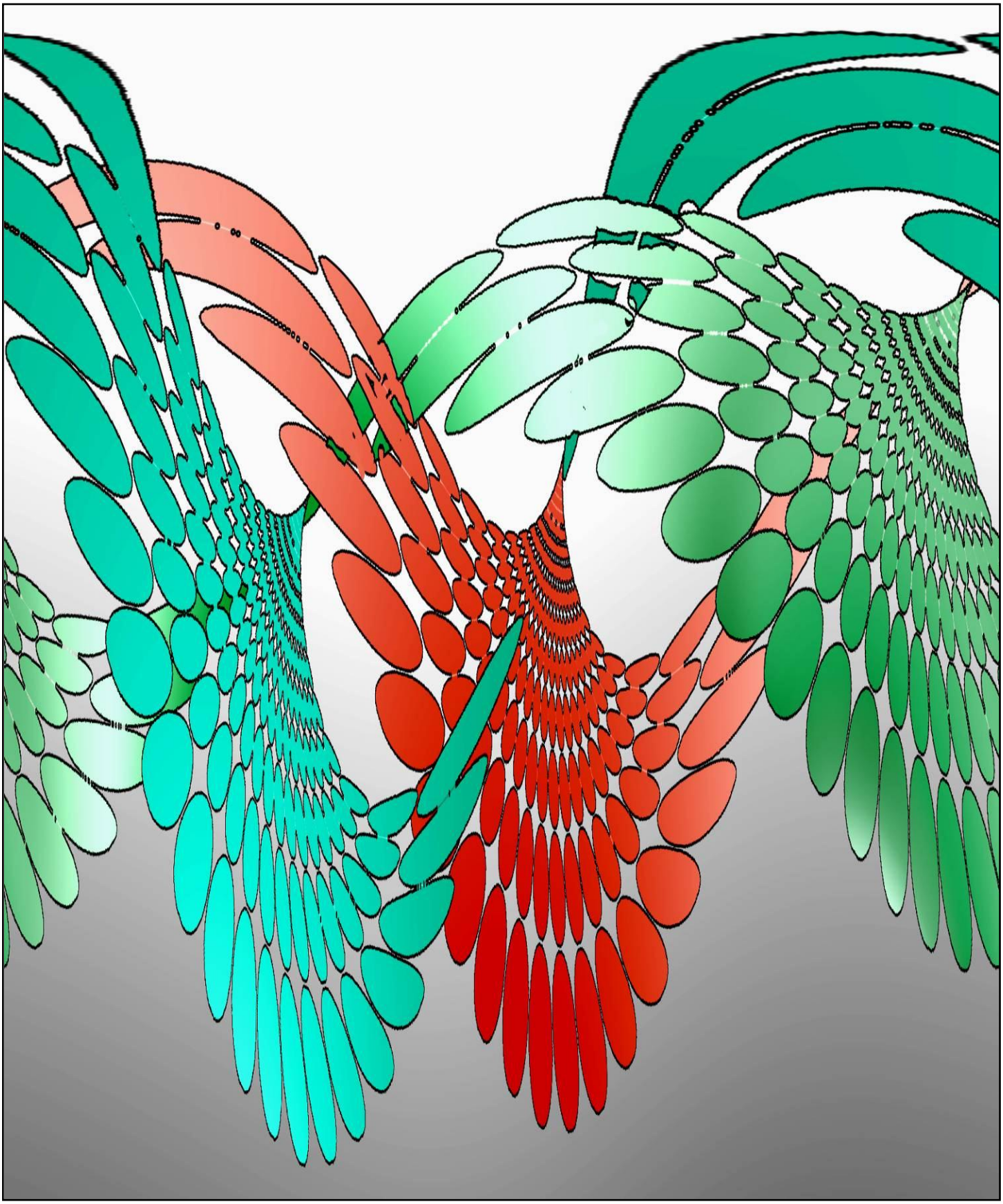


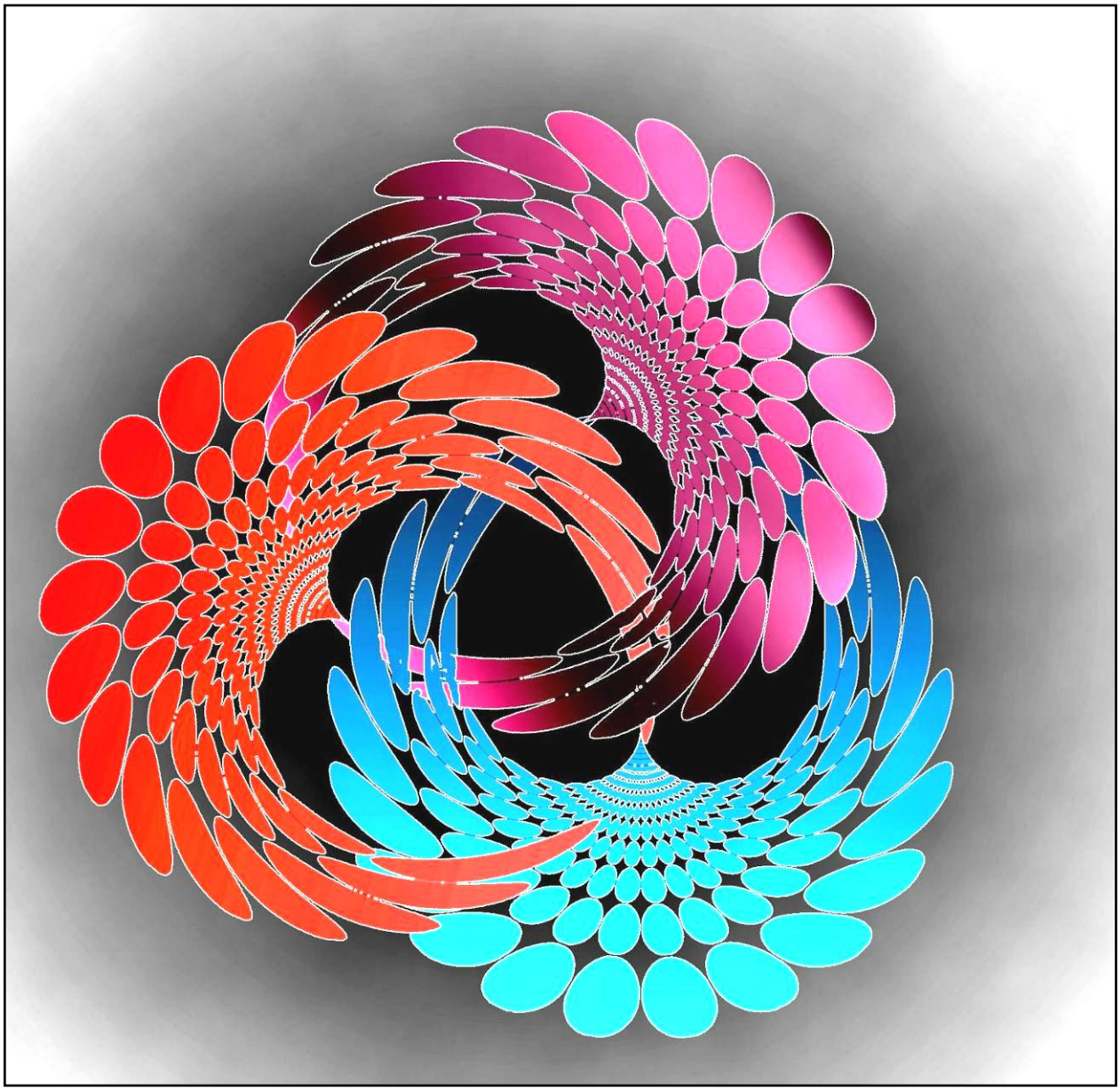


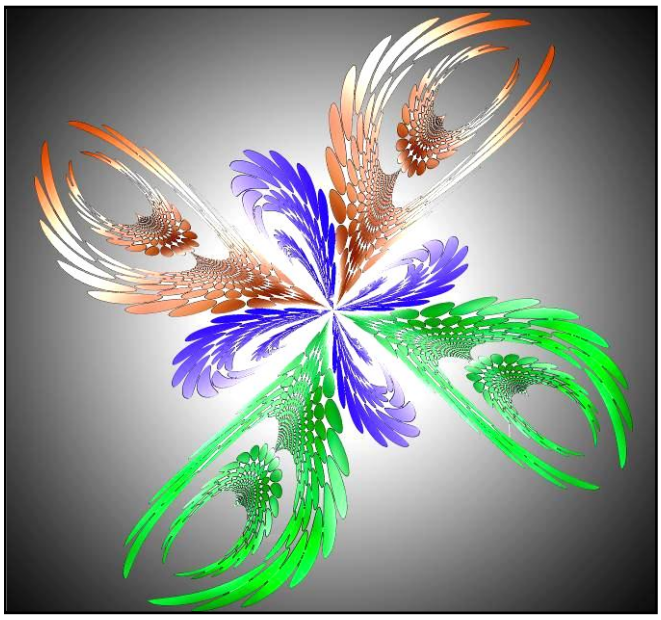


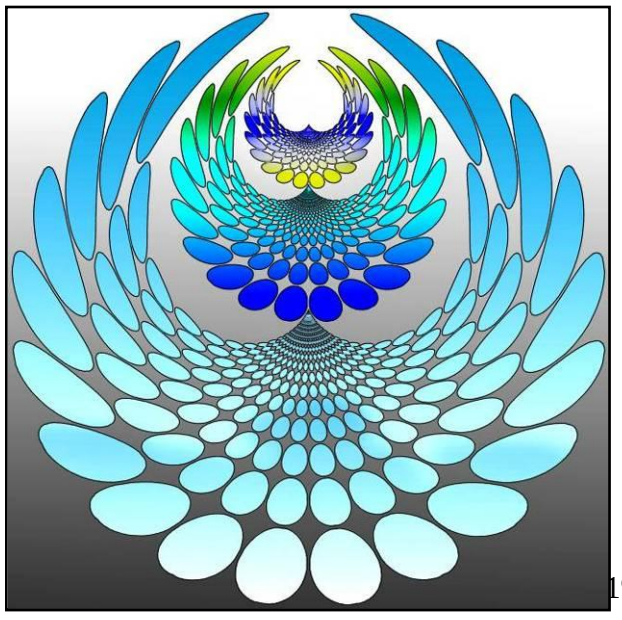


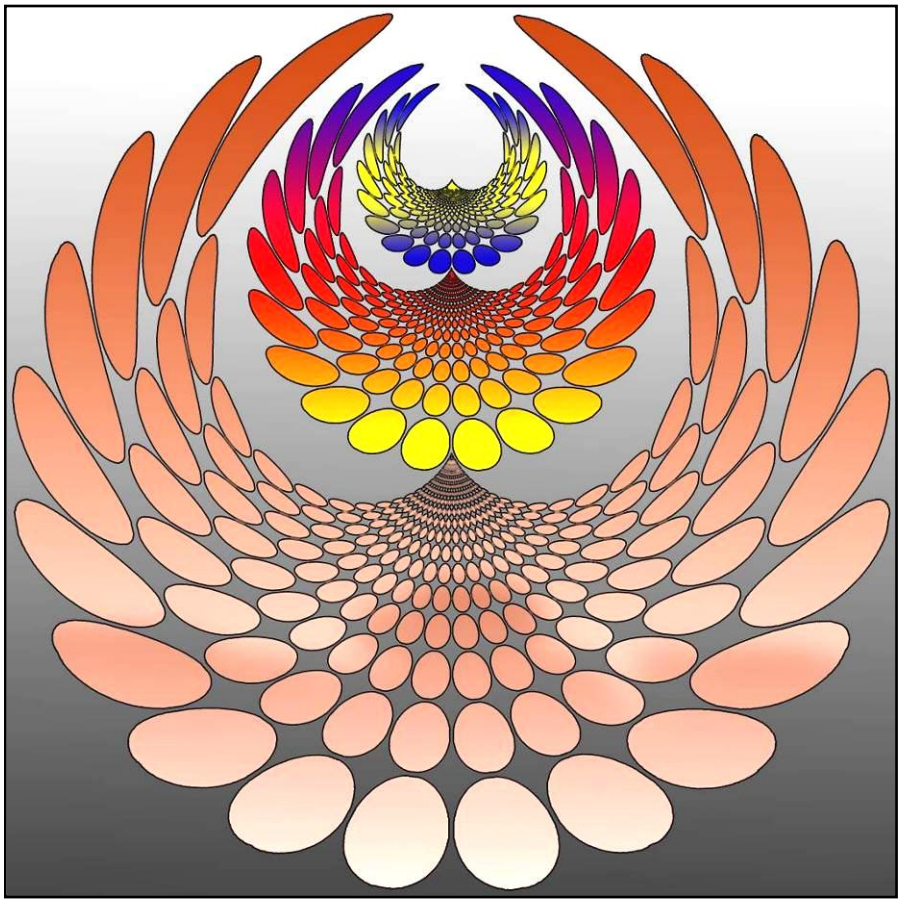


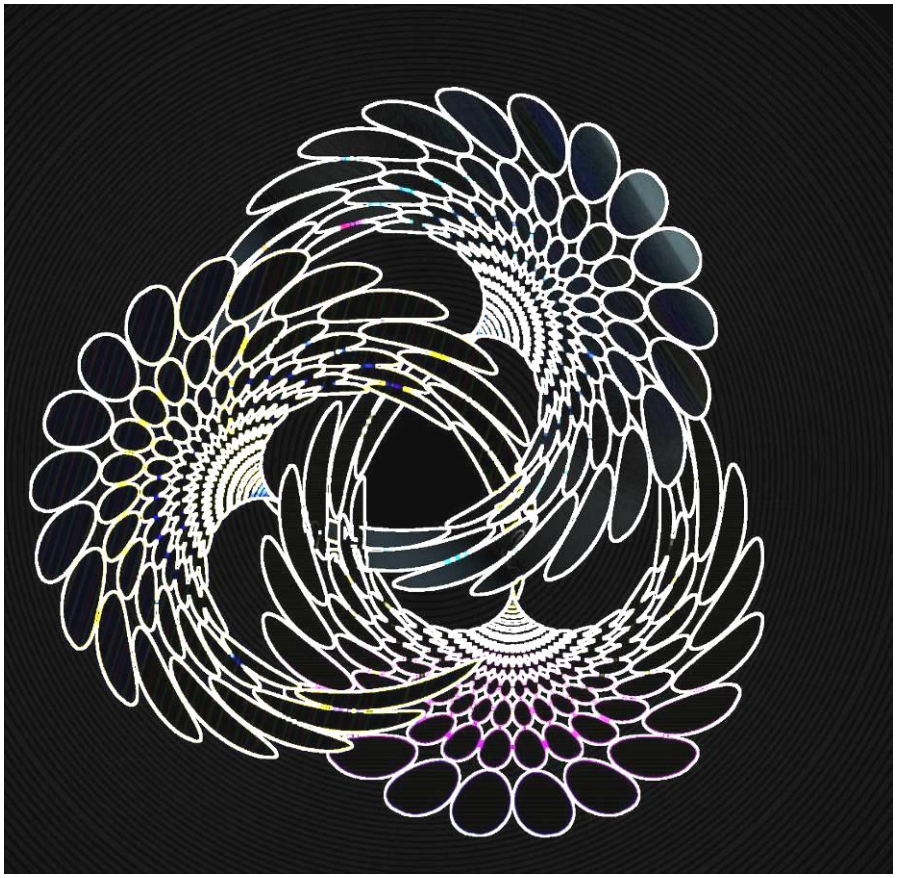


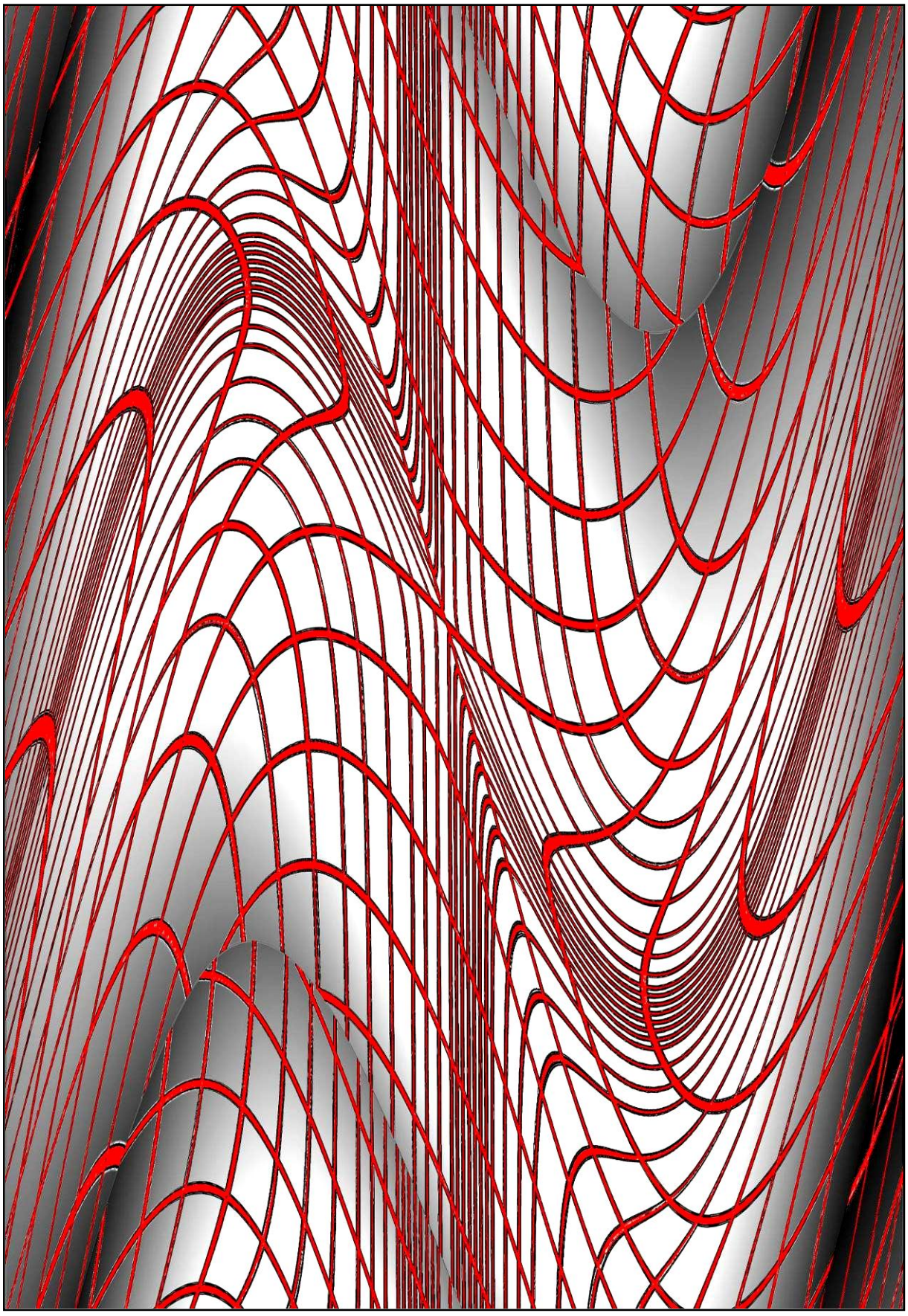




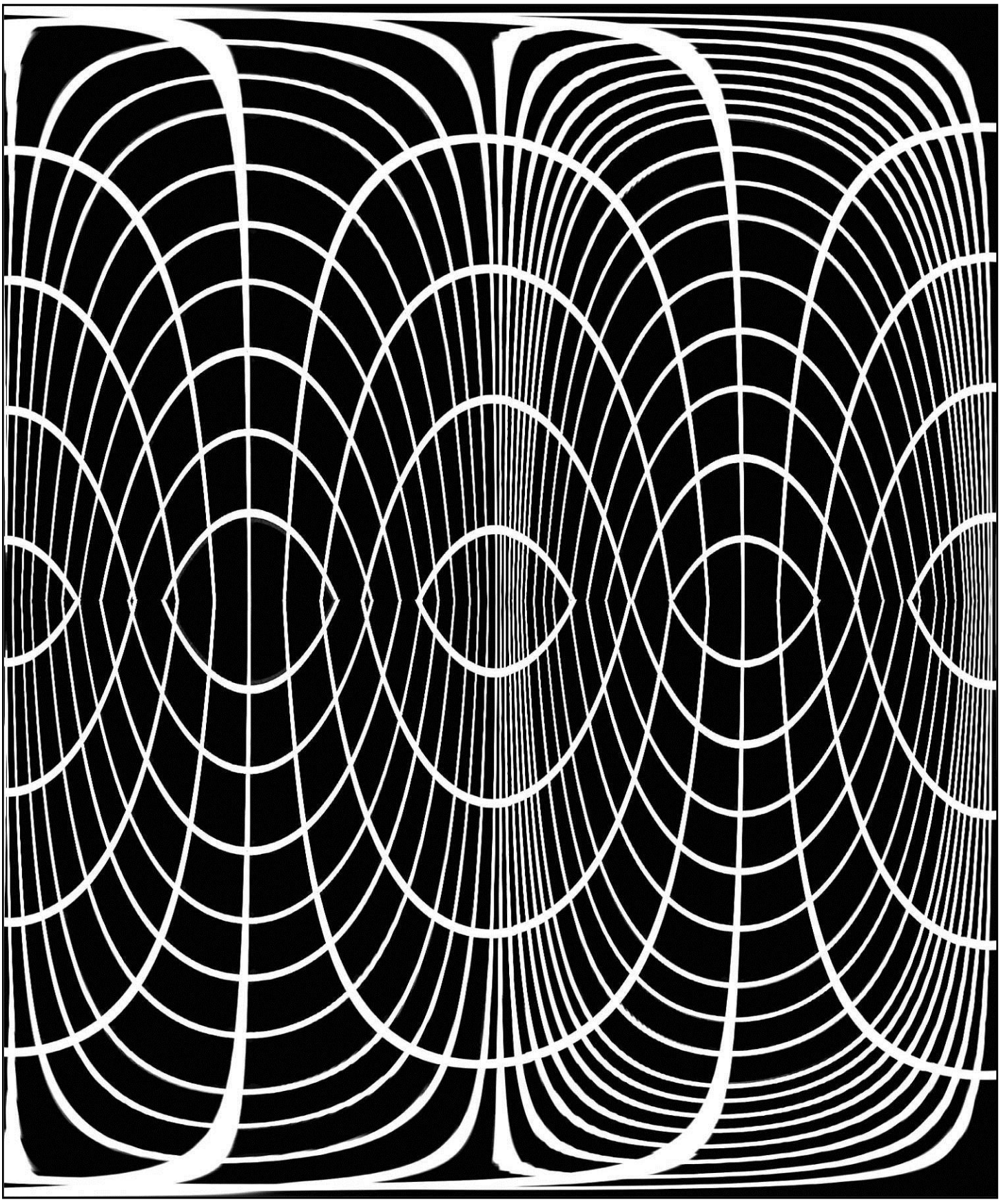


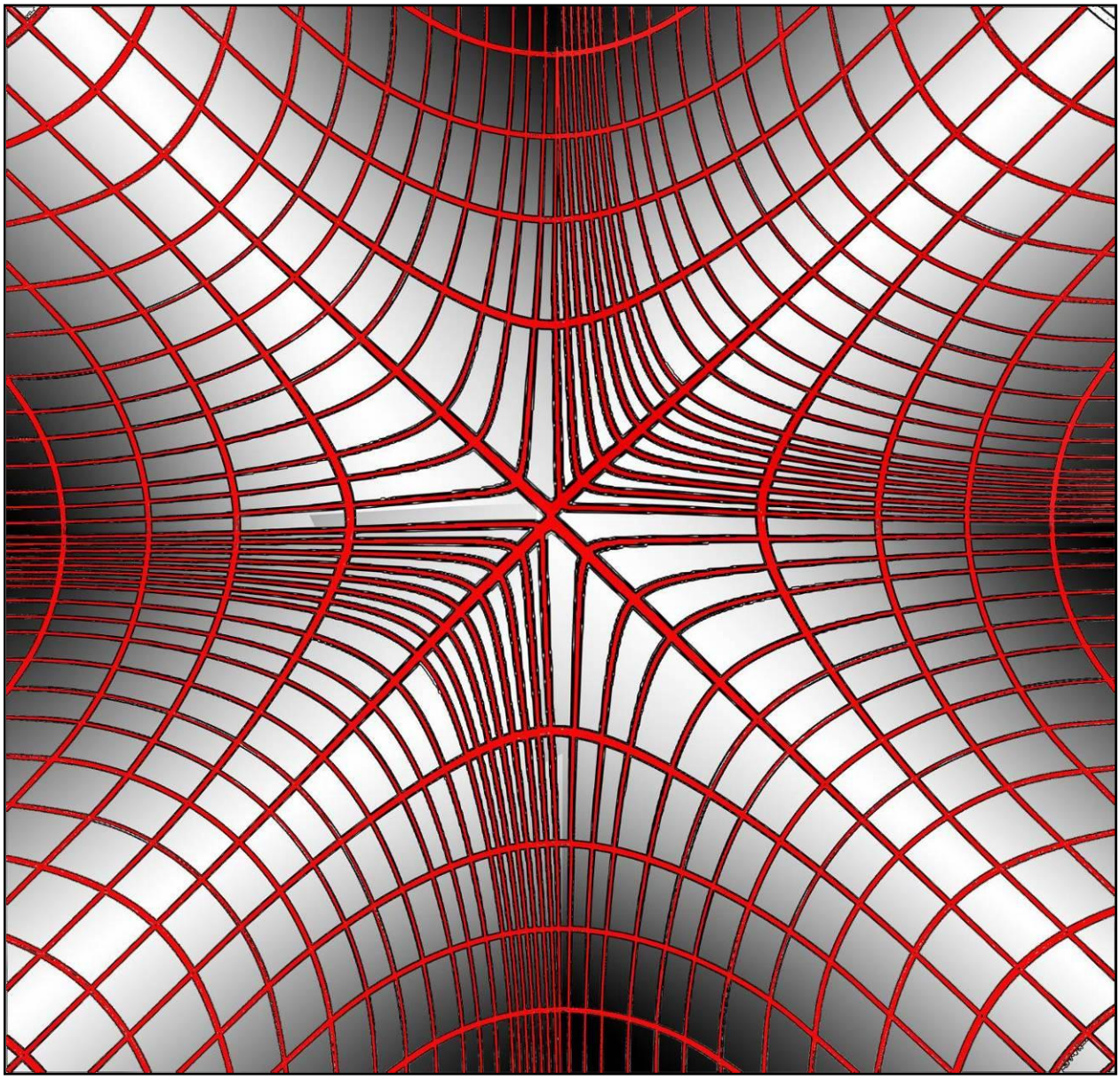


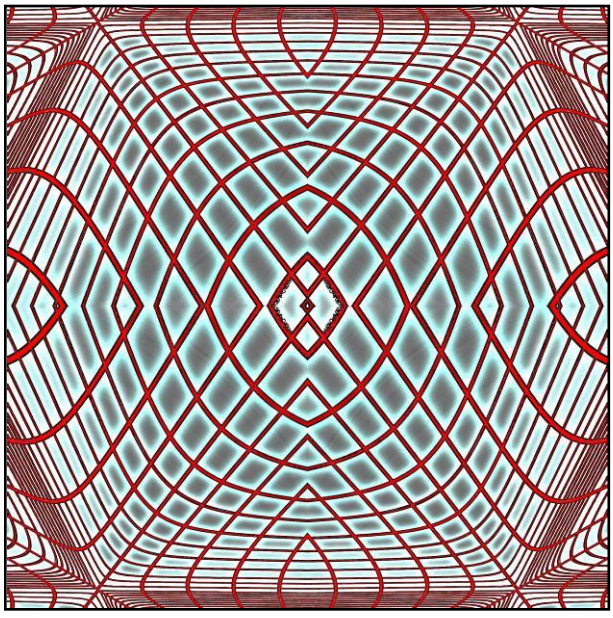


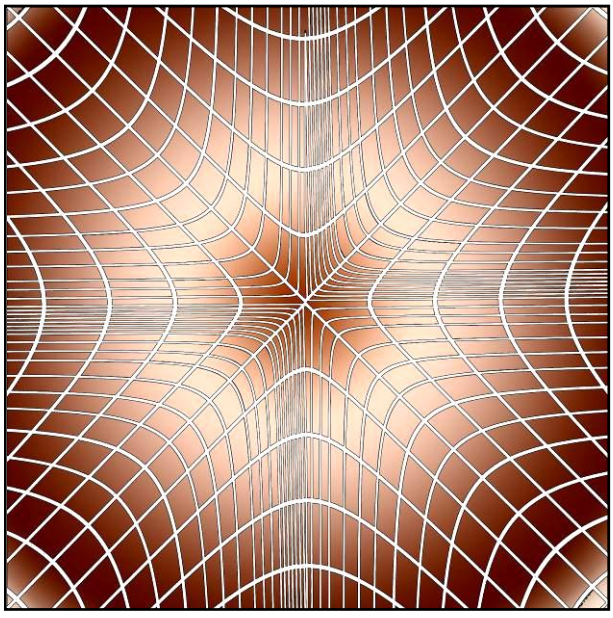


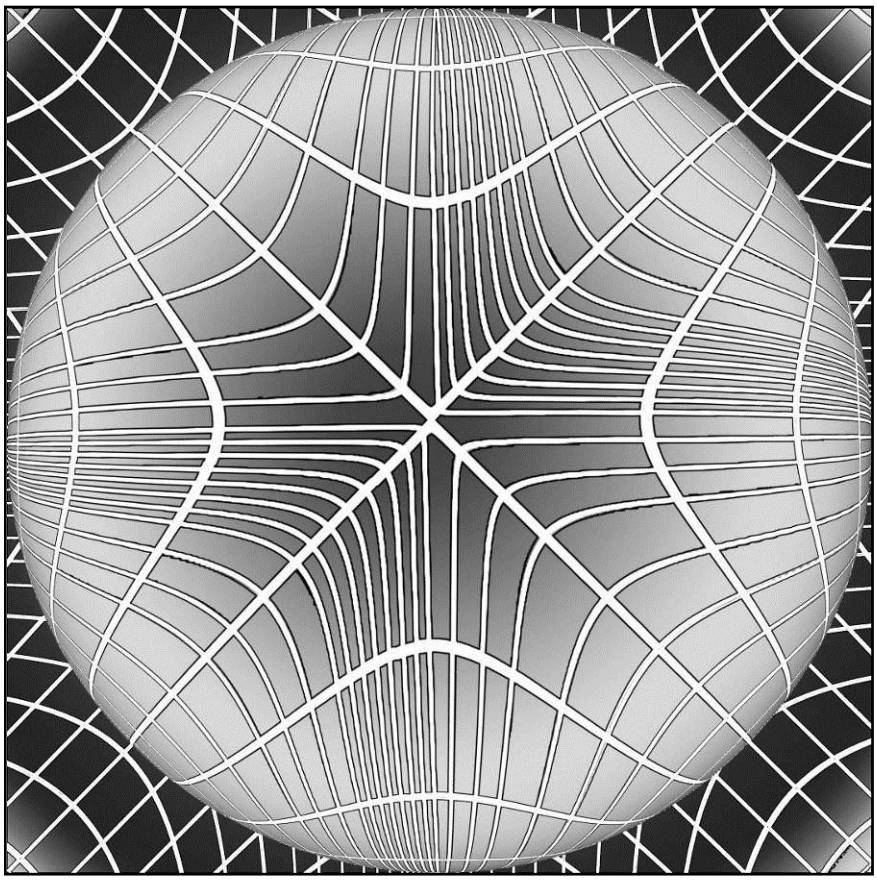
CONSTRUCTION

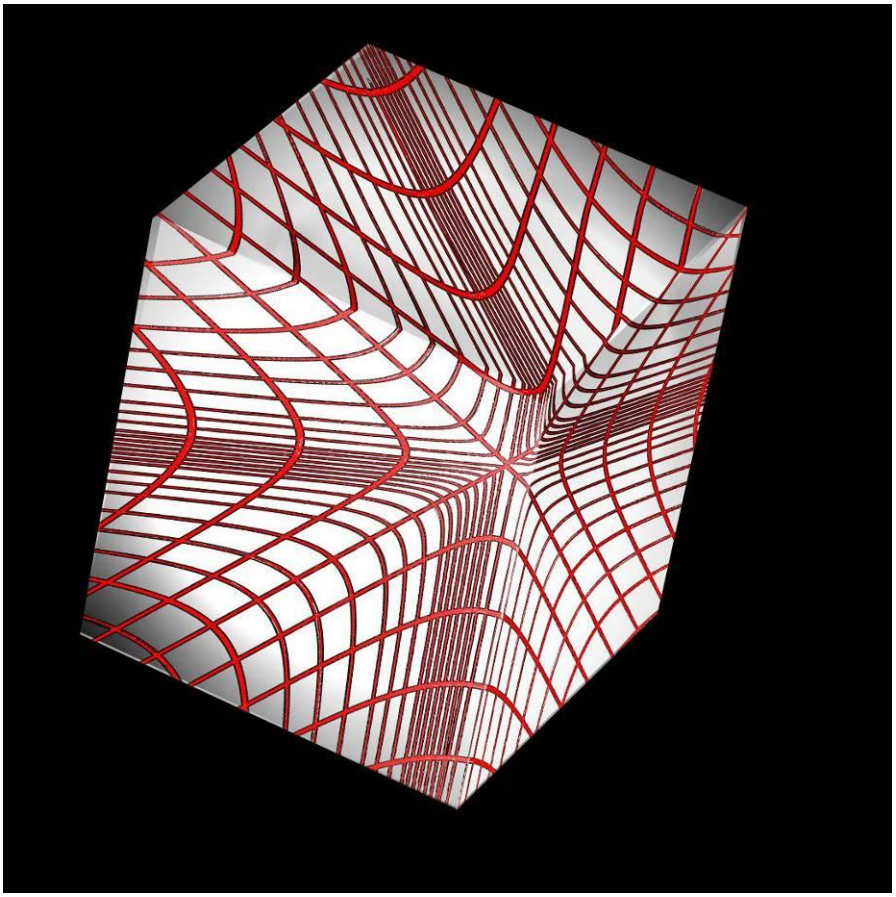












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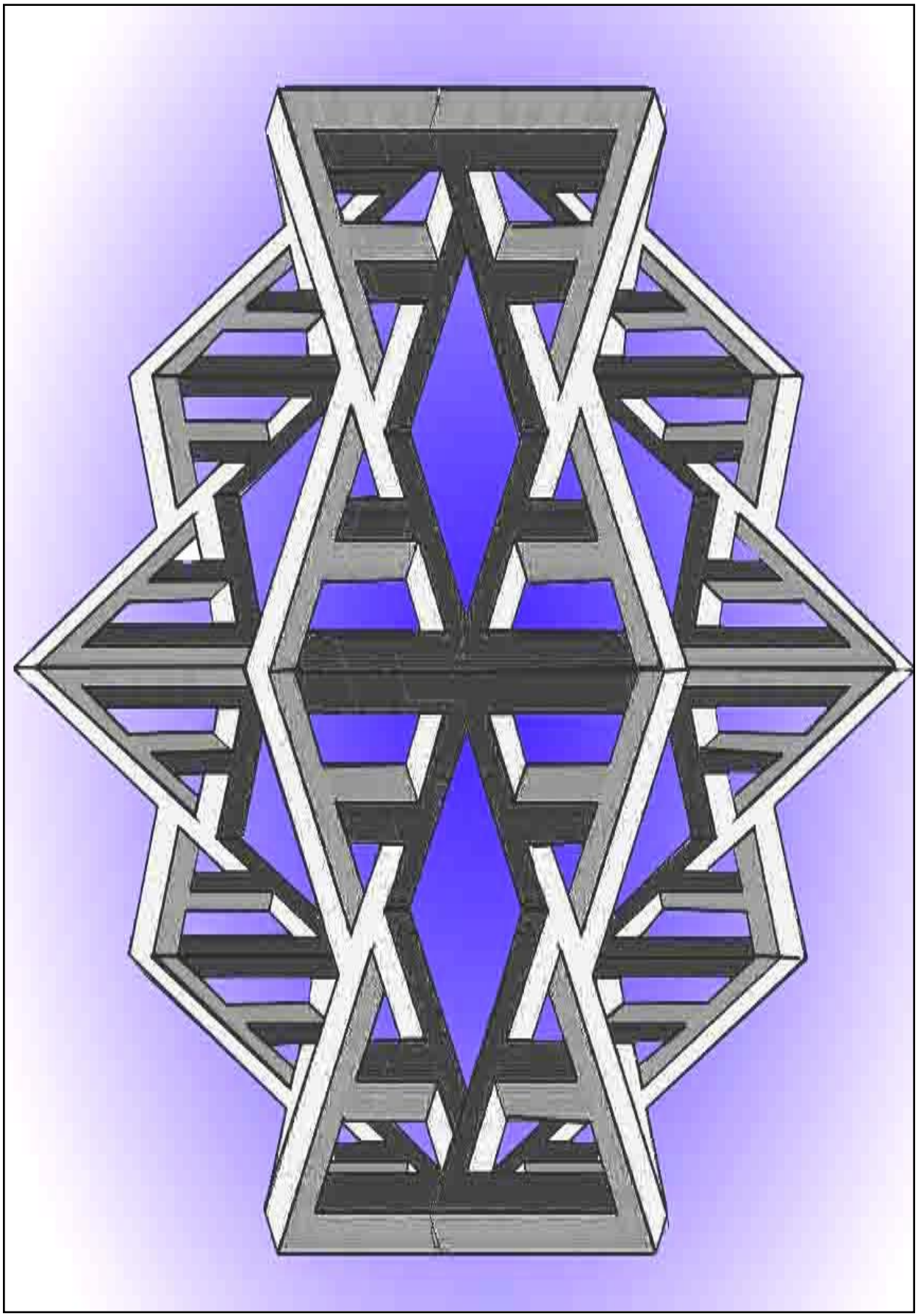

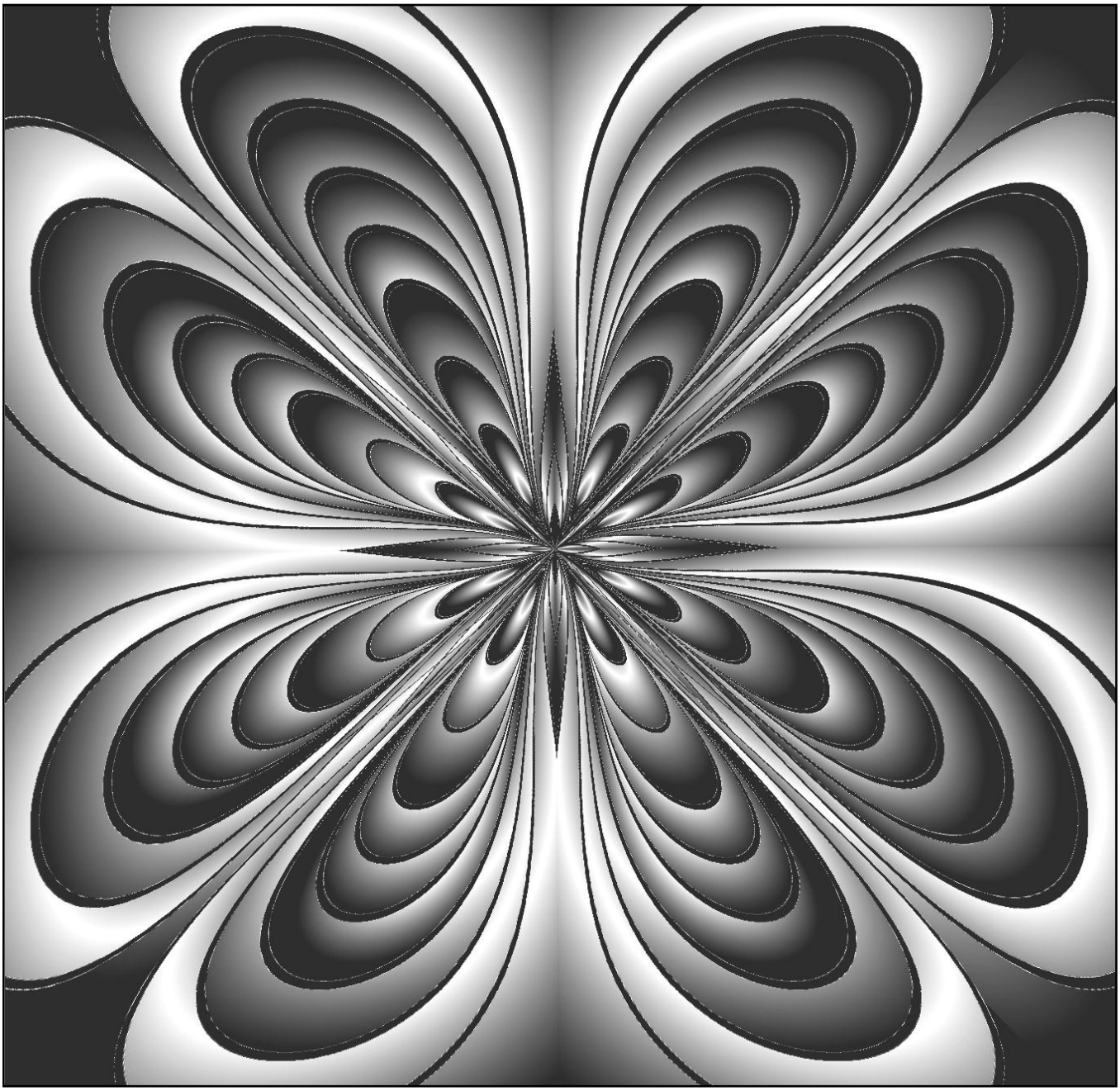

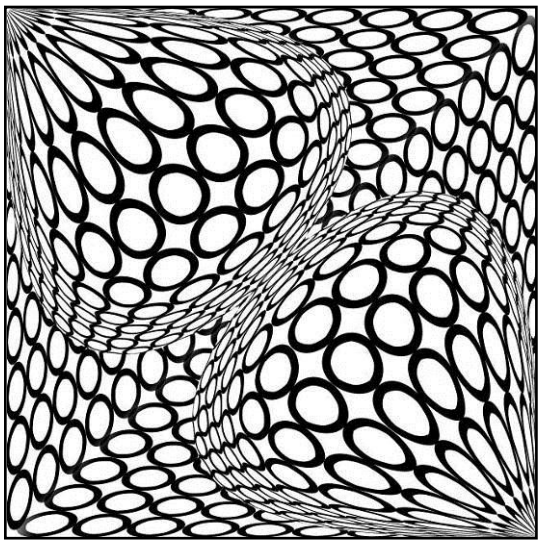

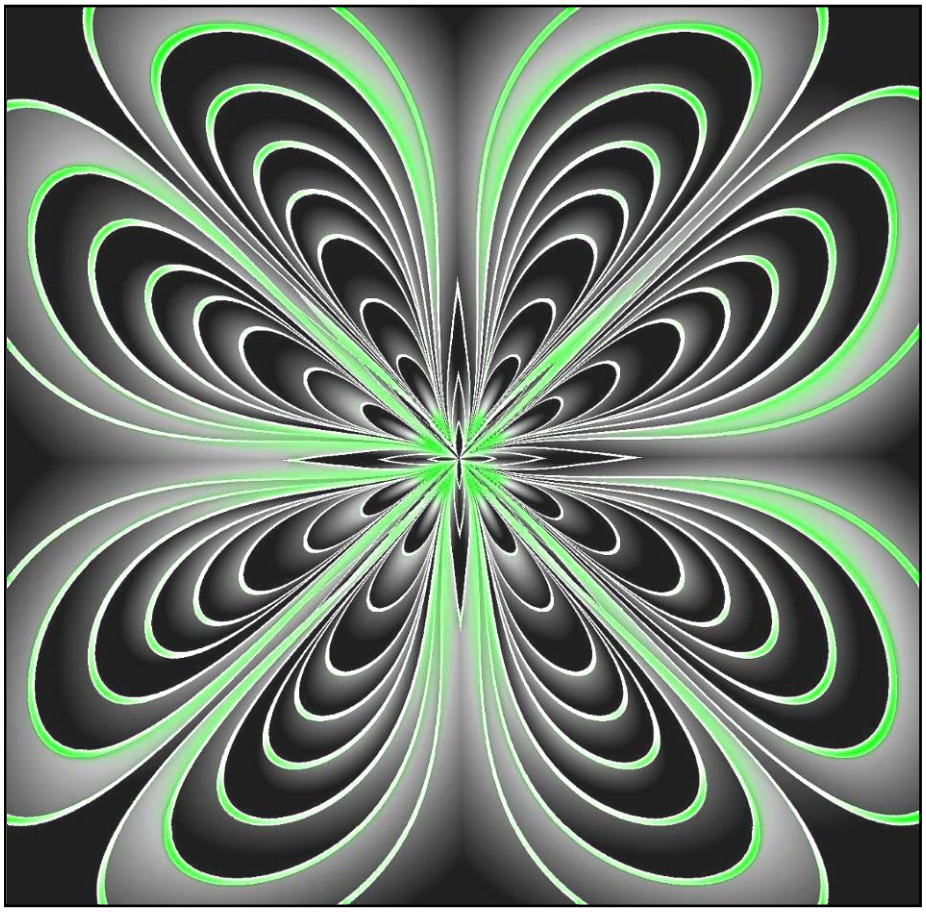

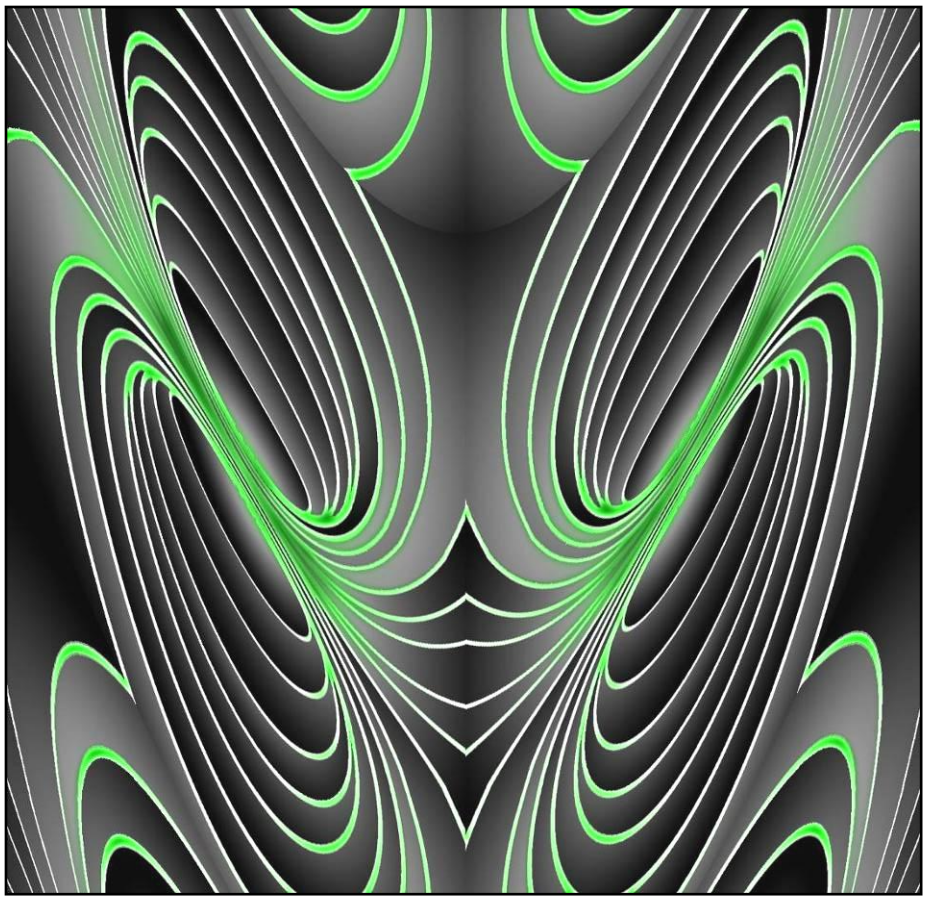

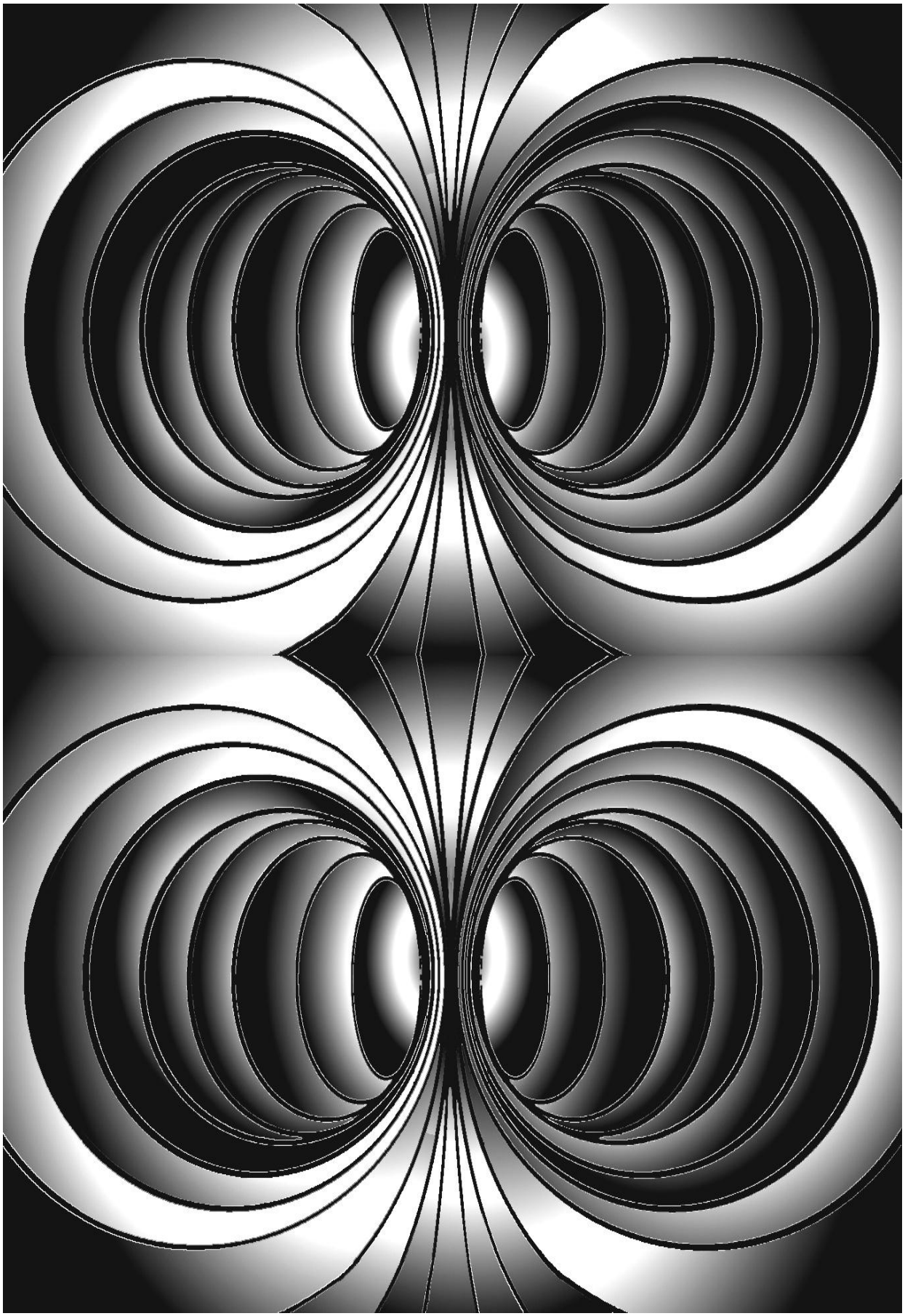

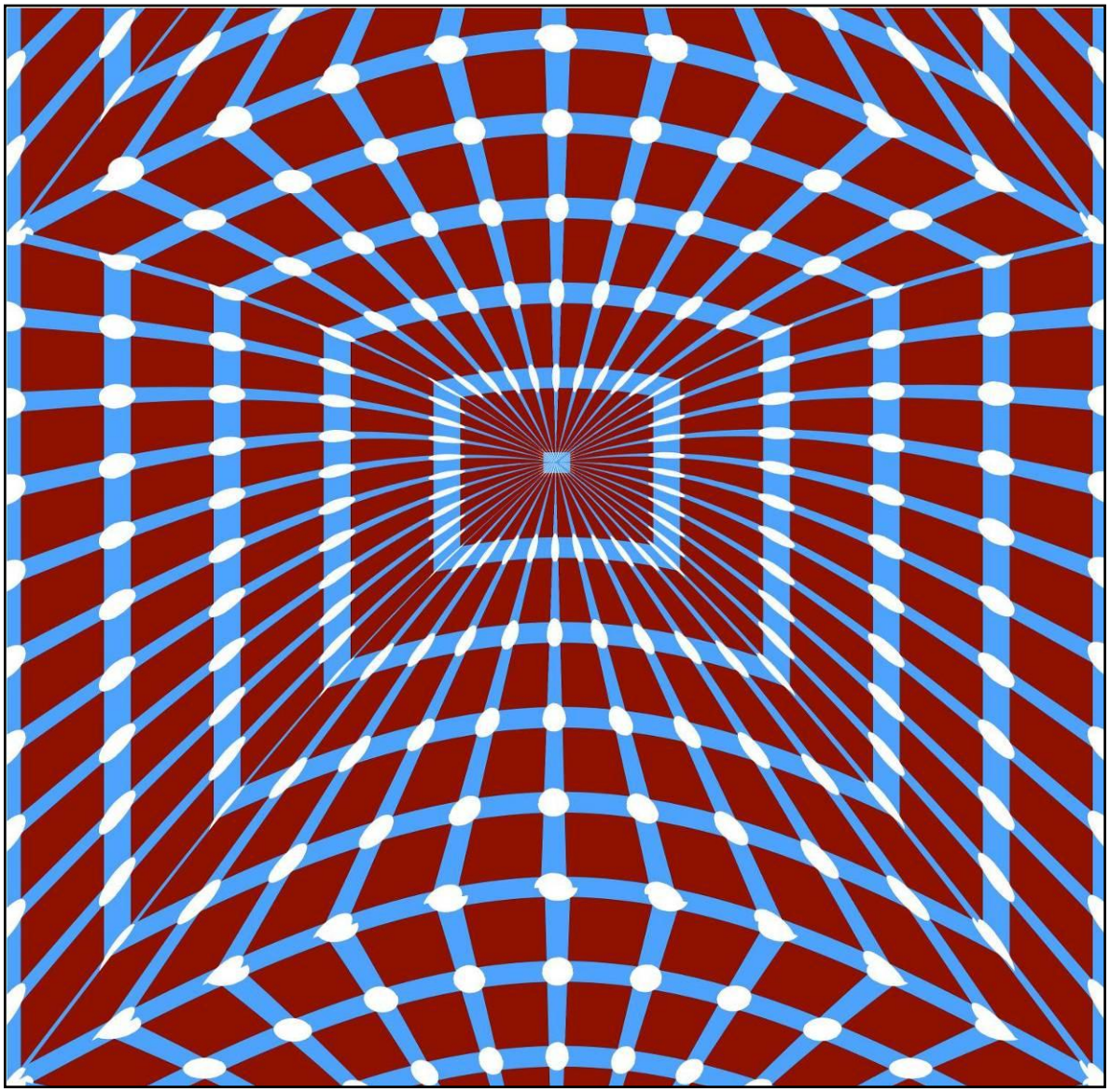

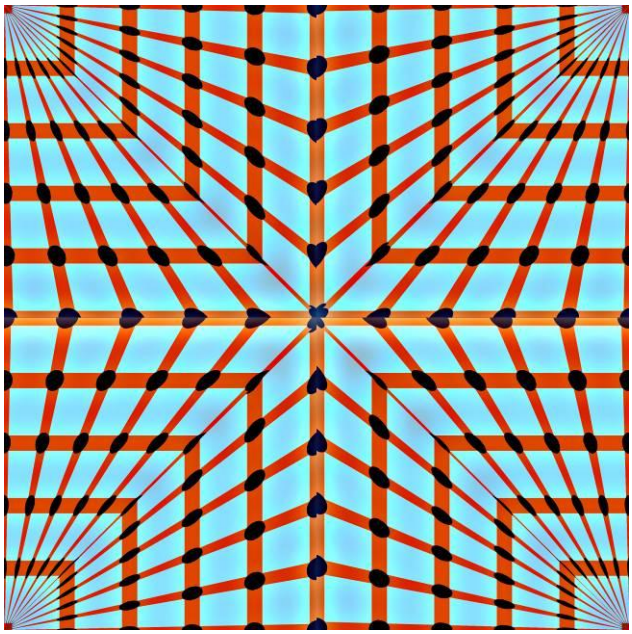

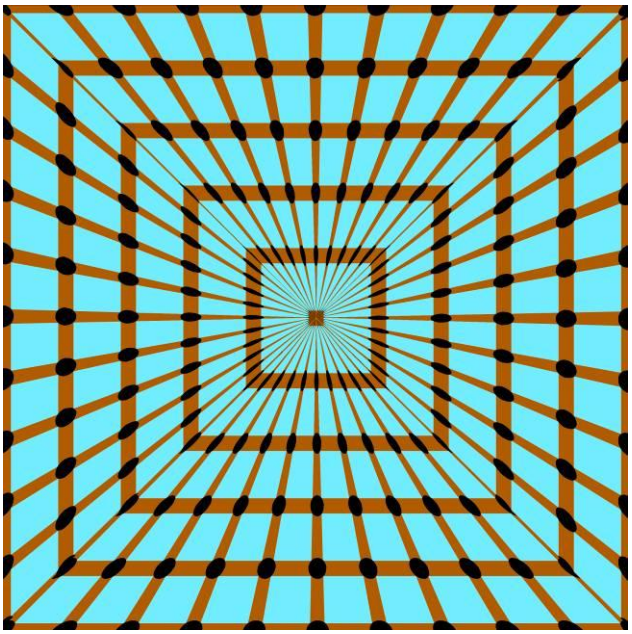

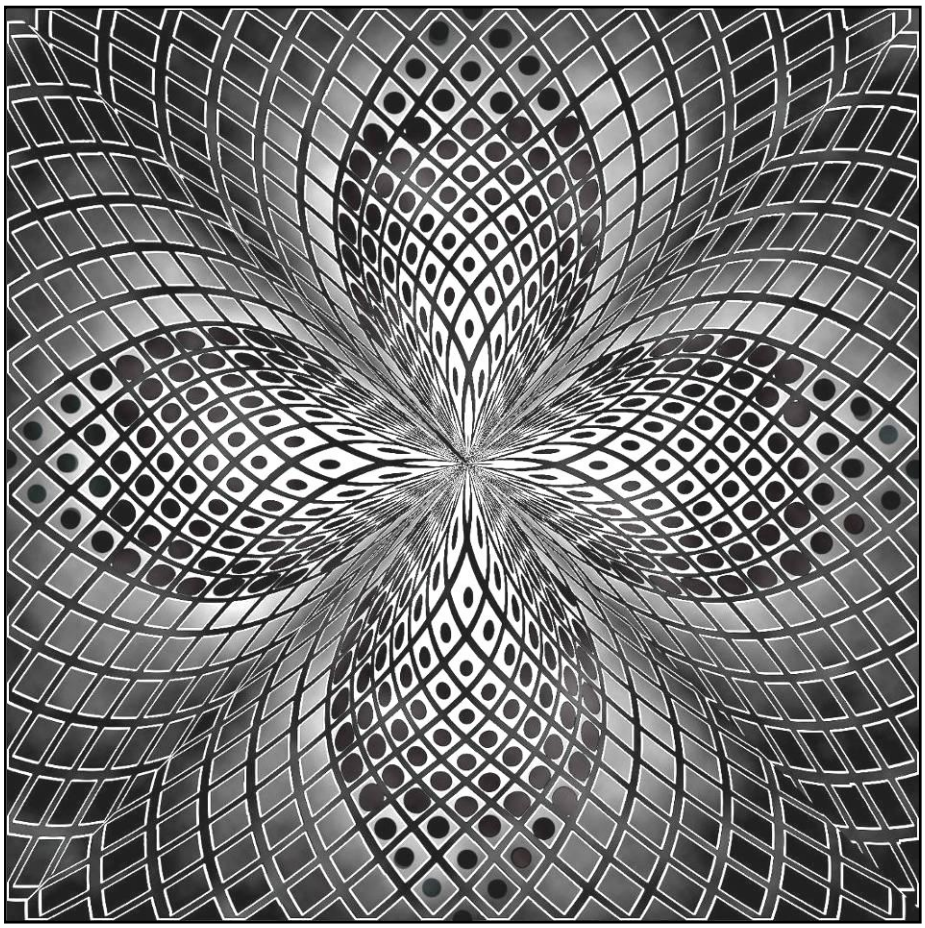

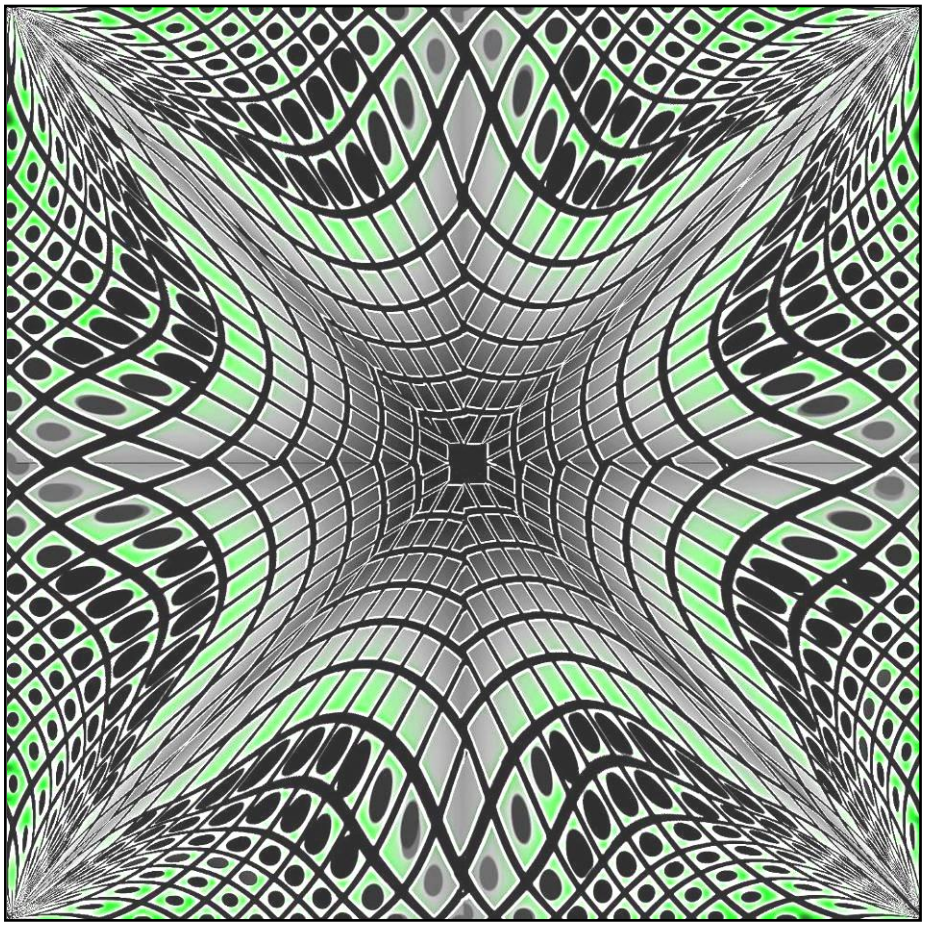

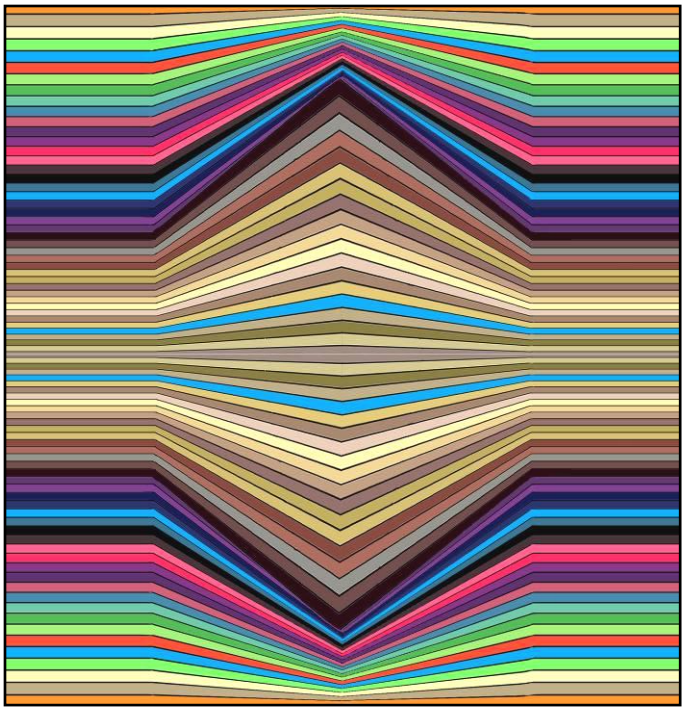

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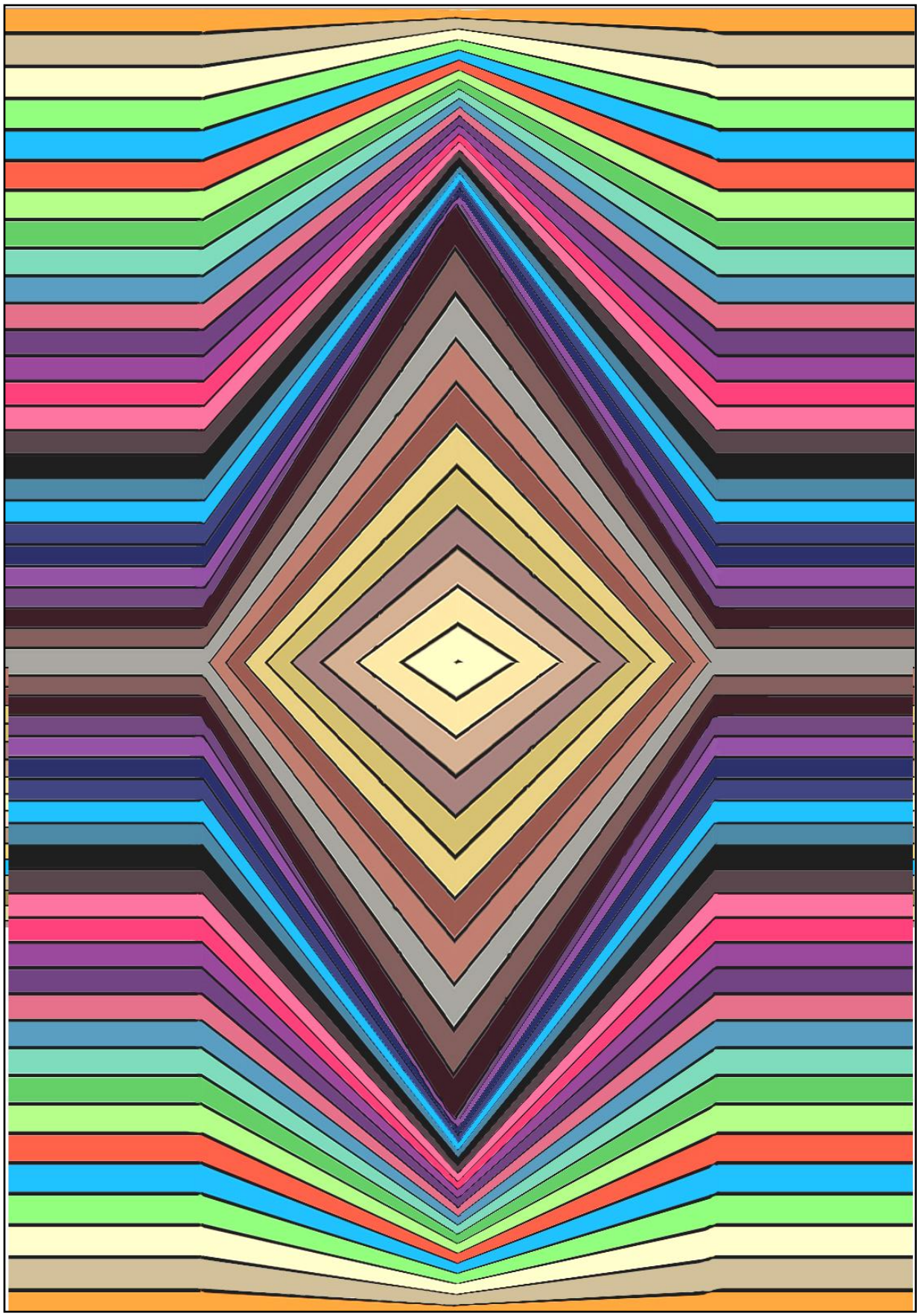

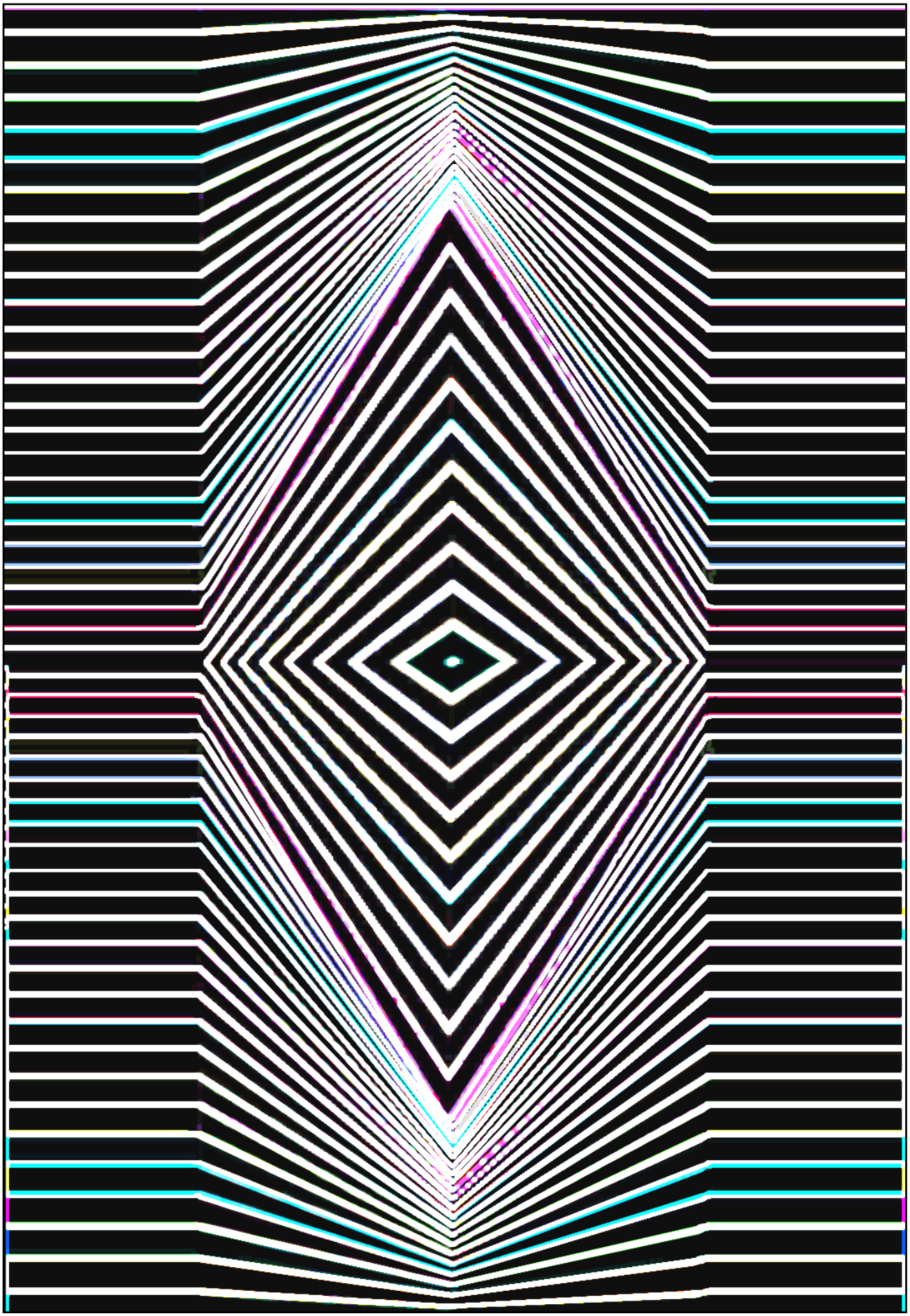

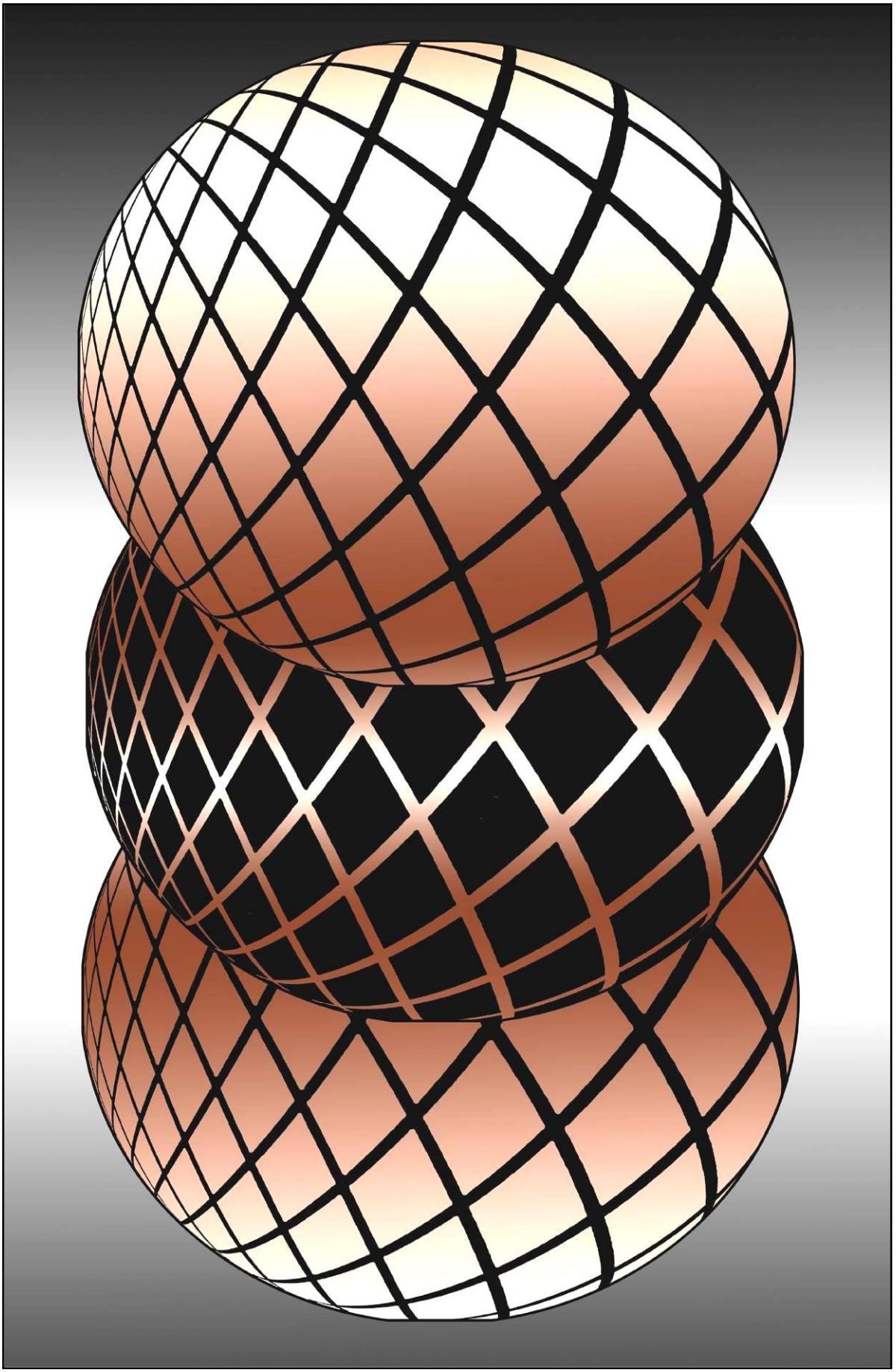

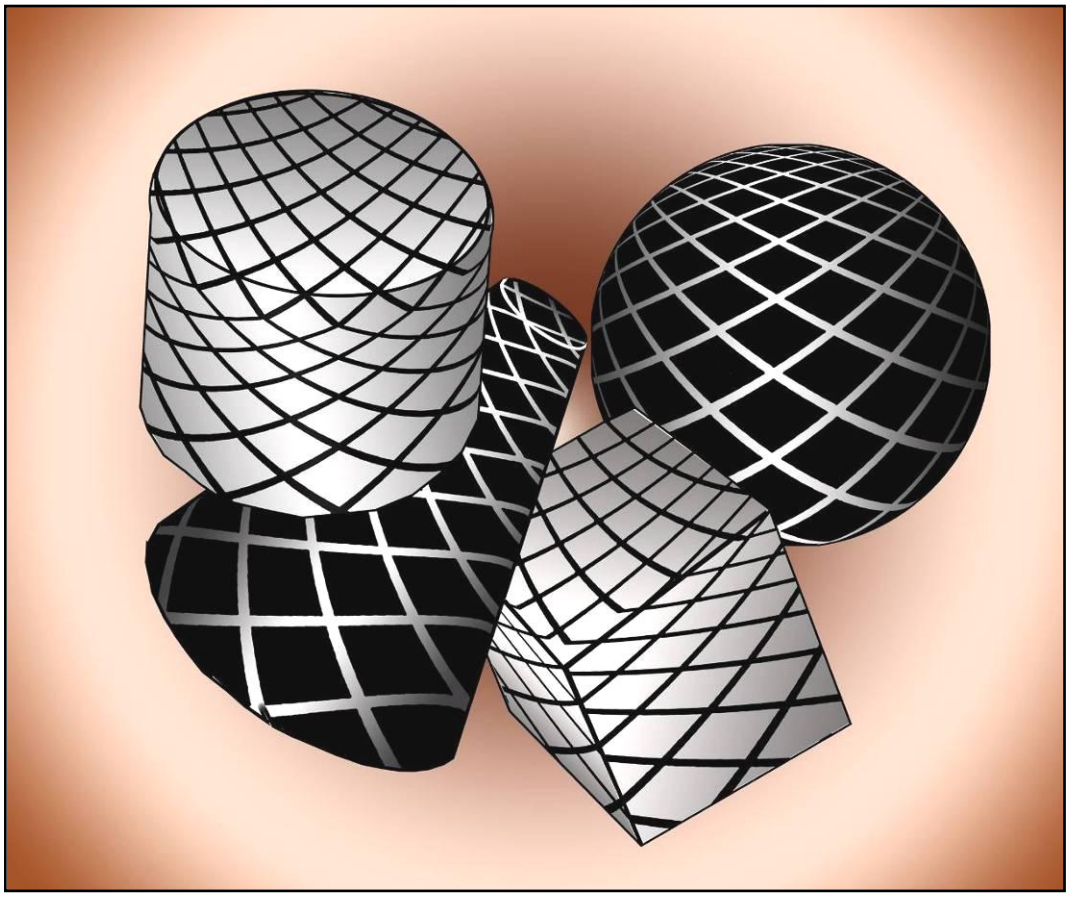

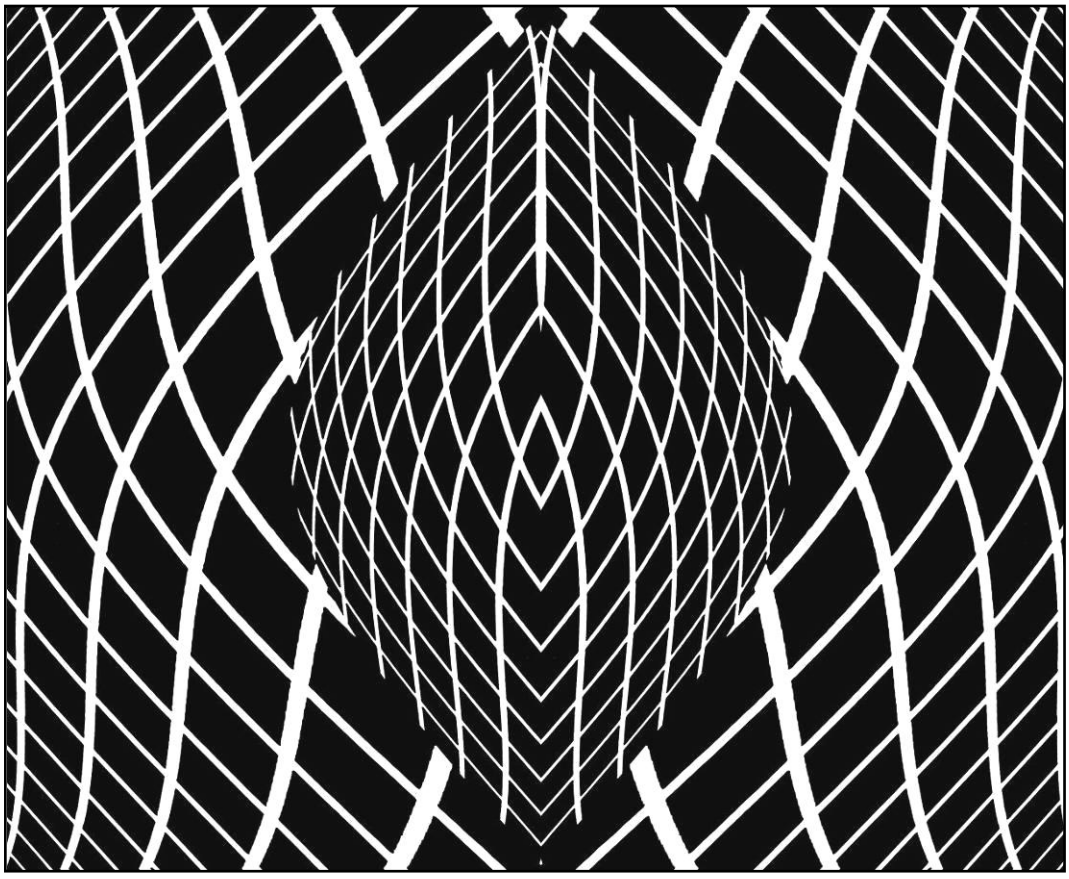

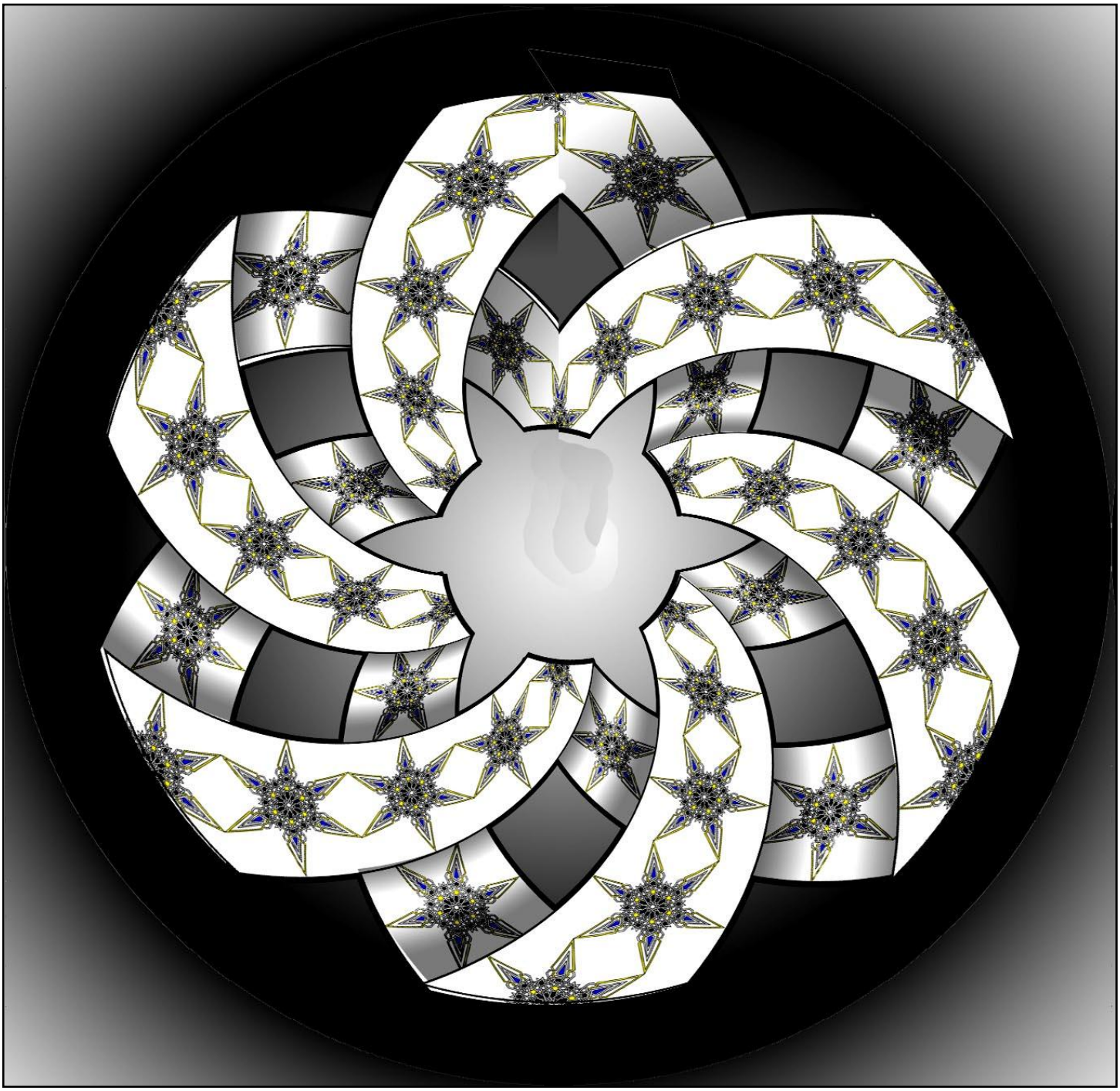

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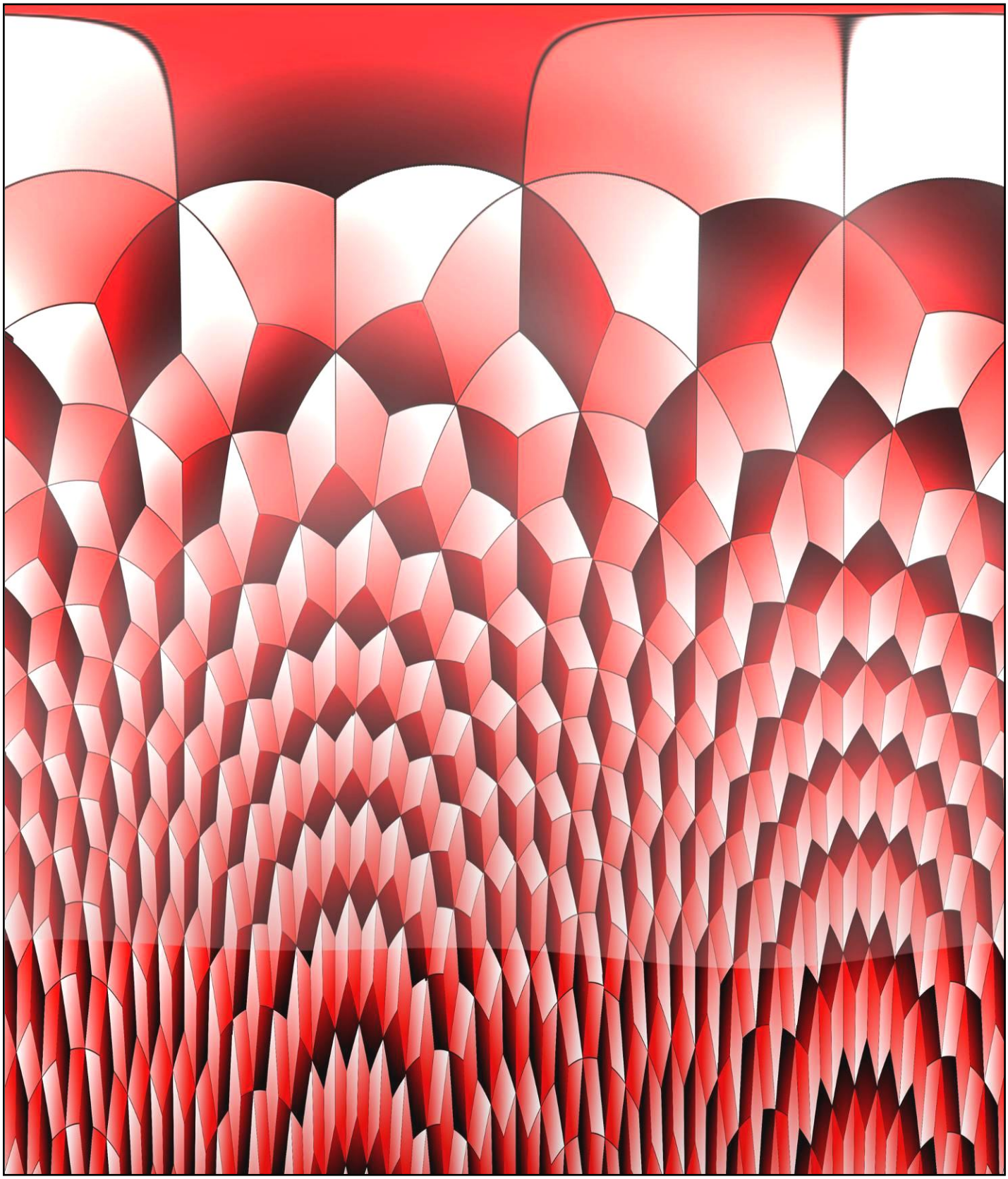

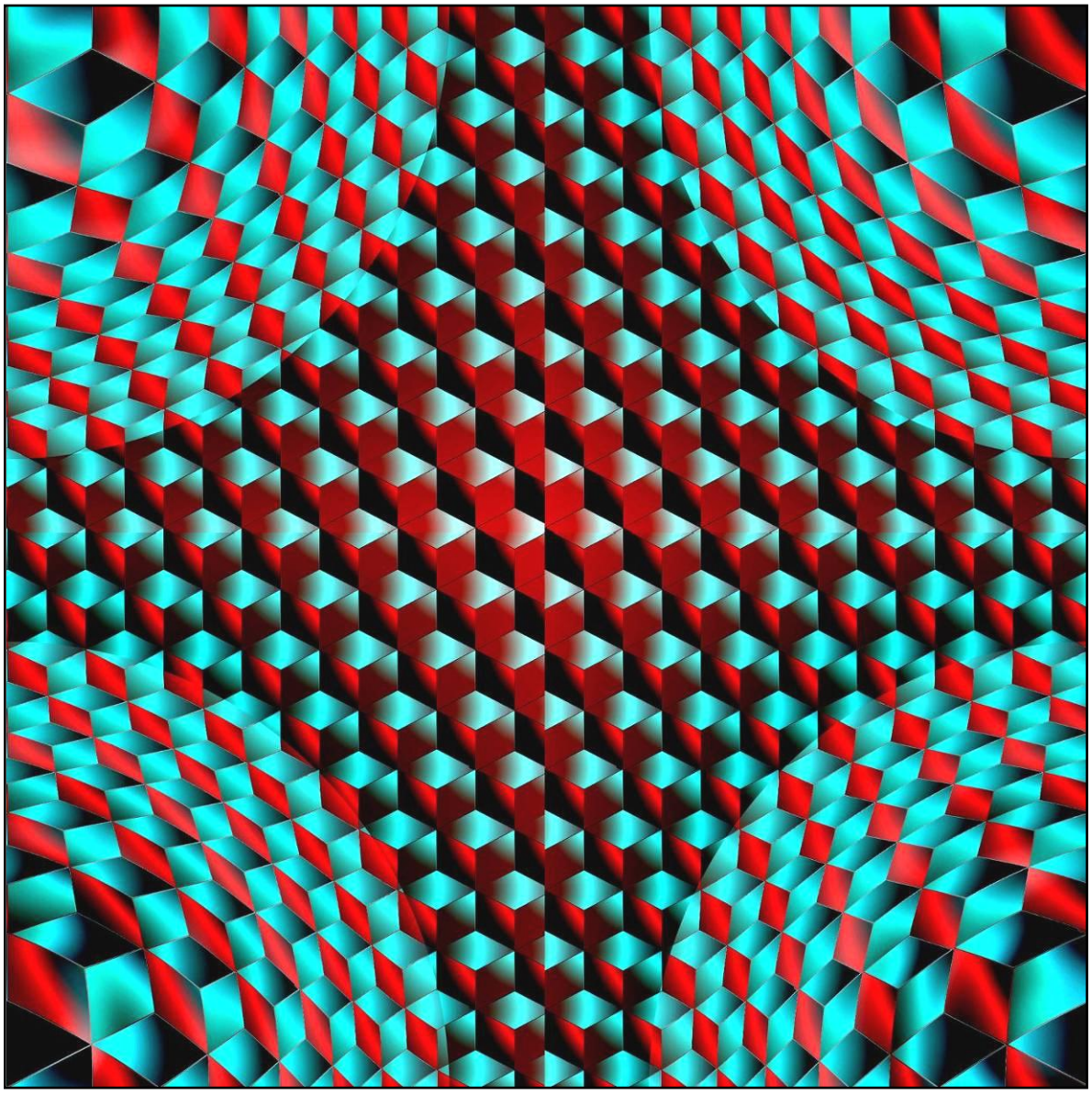

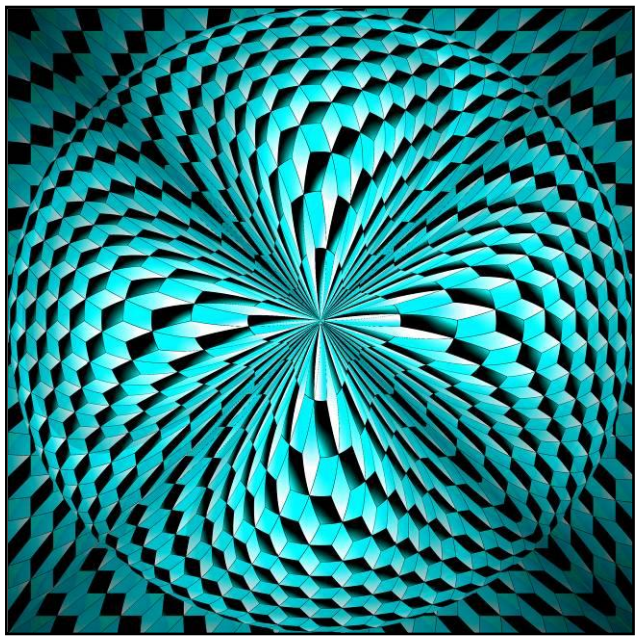

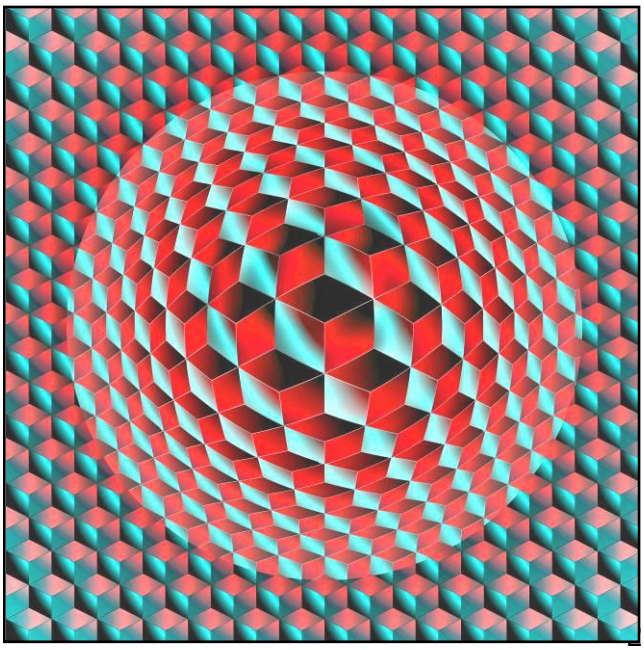

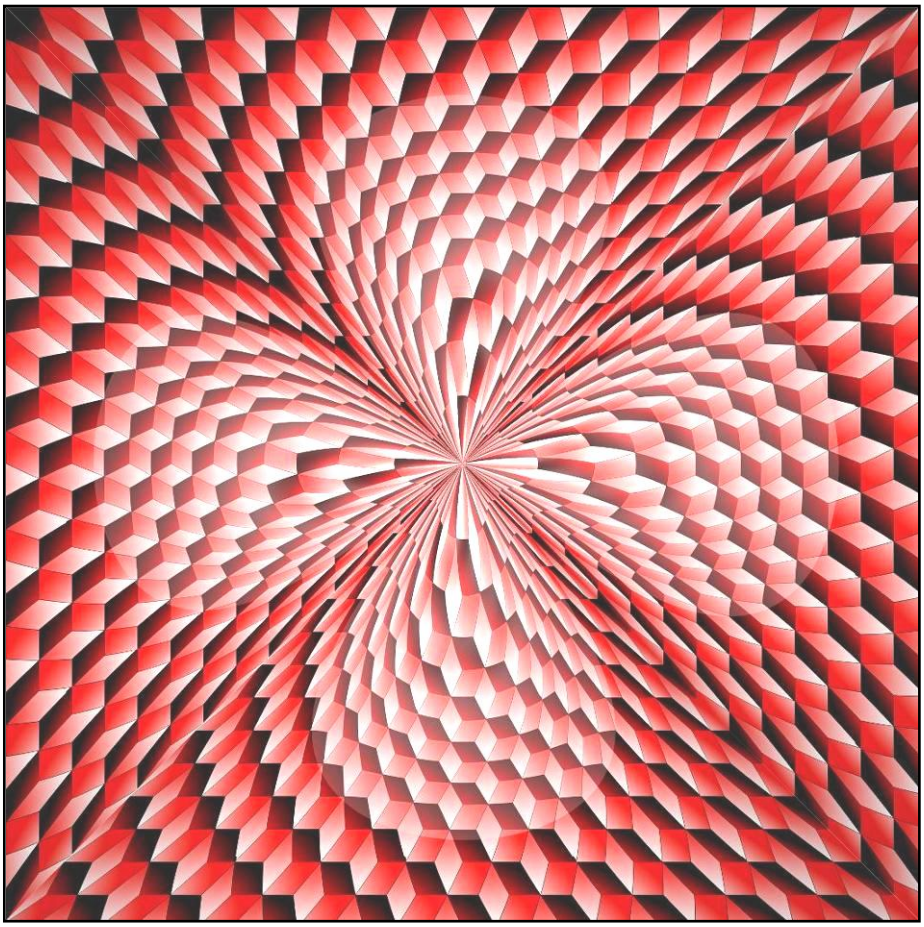

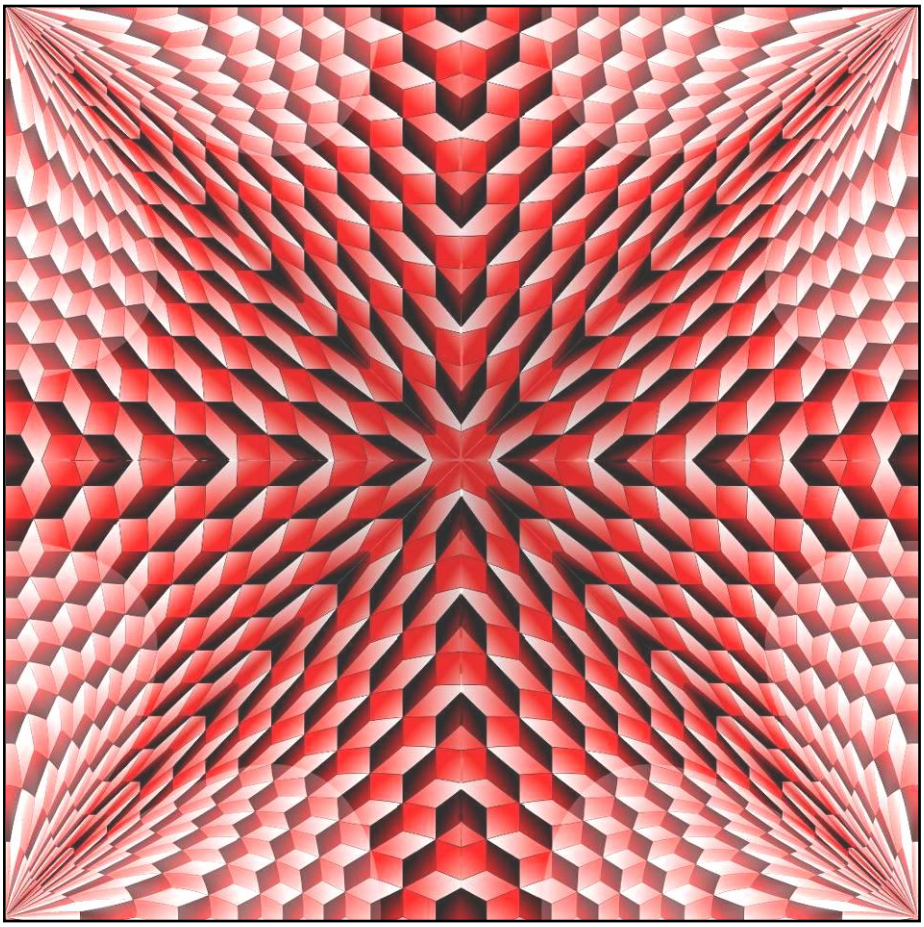

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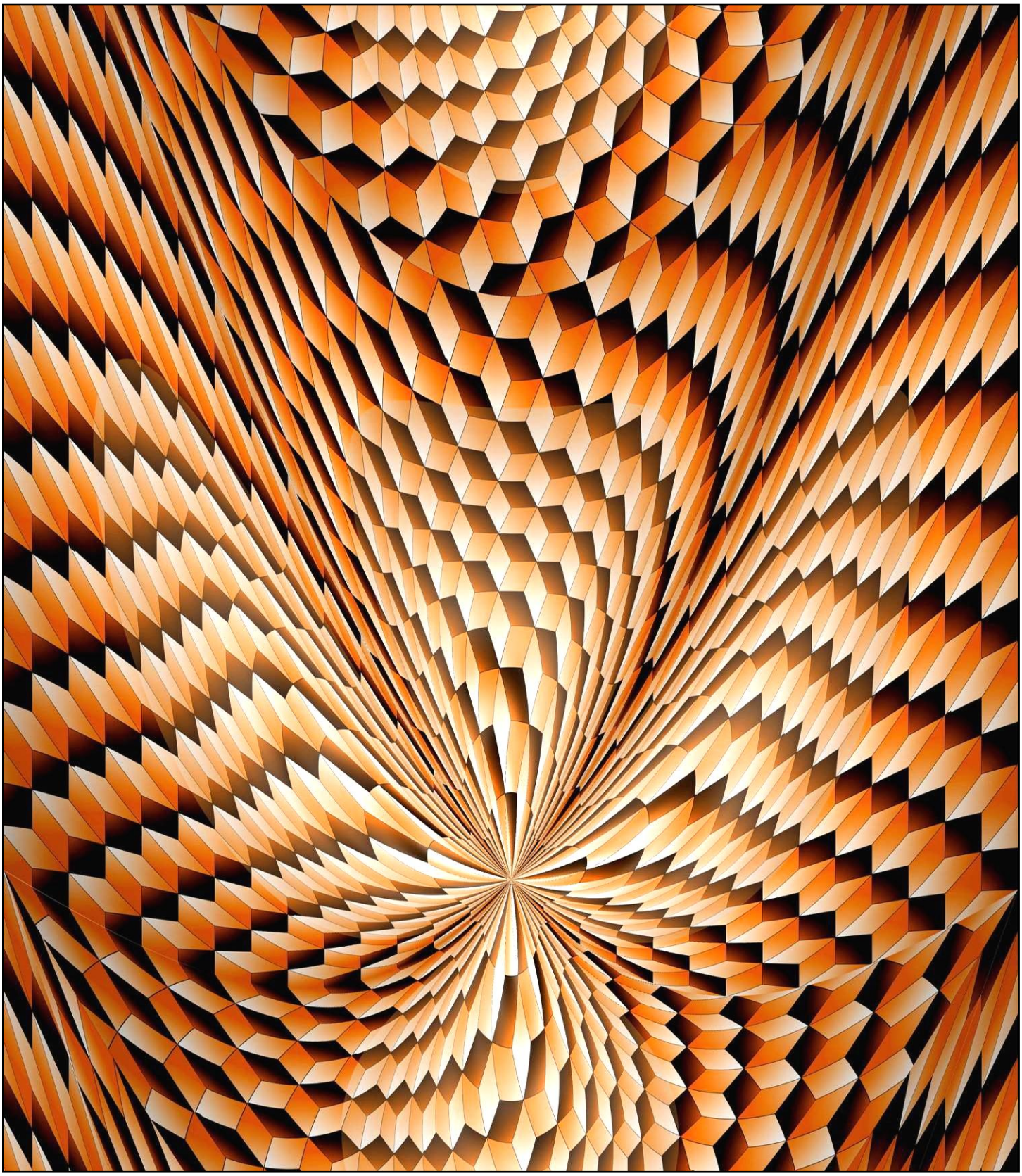

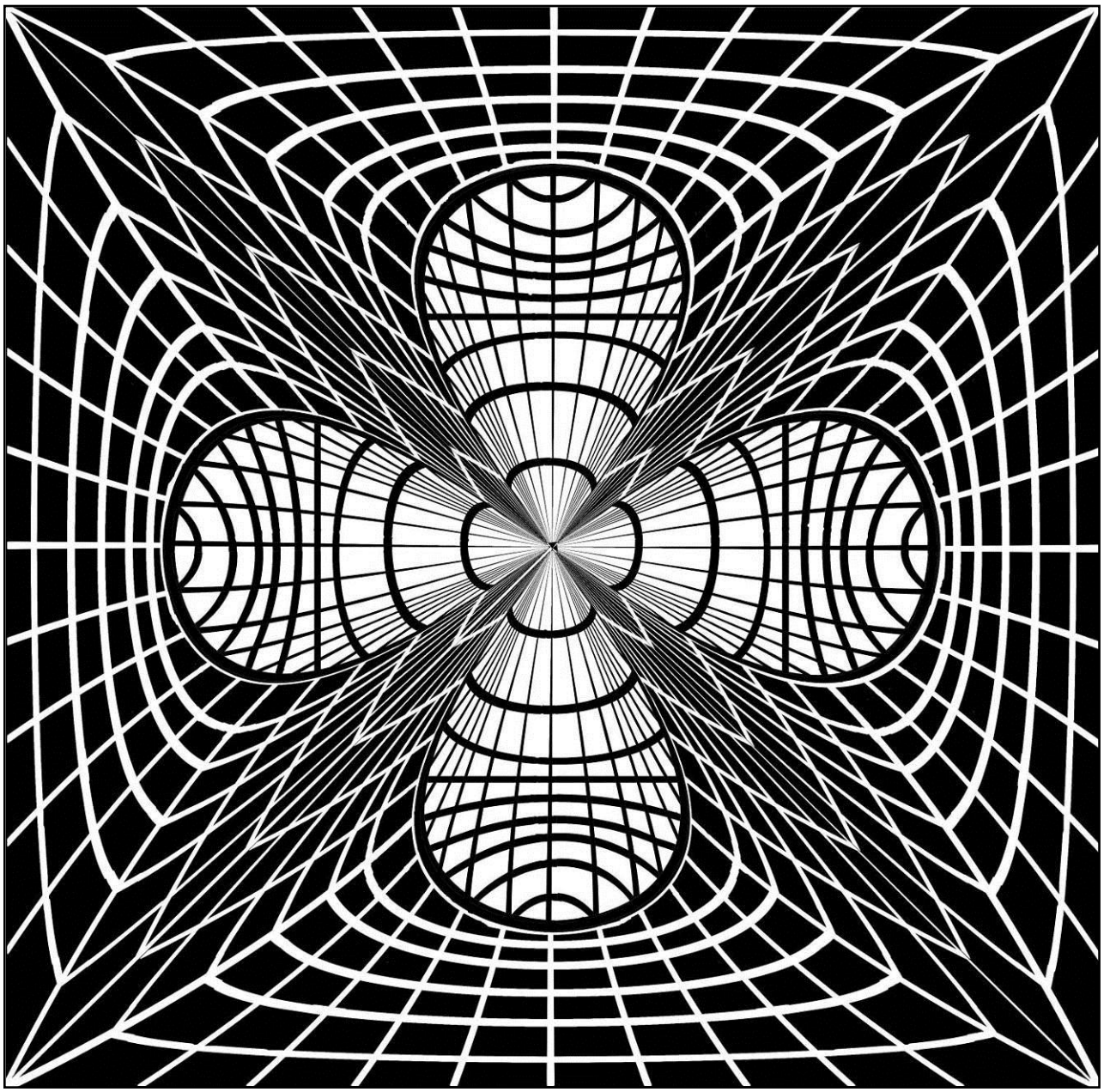

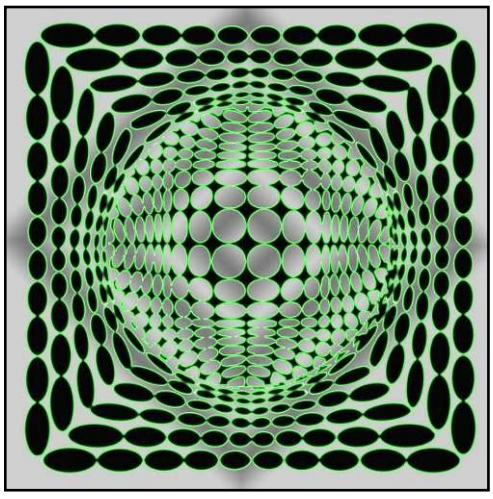

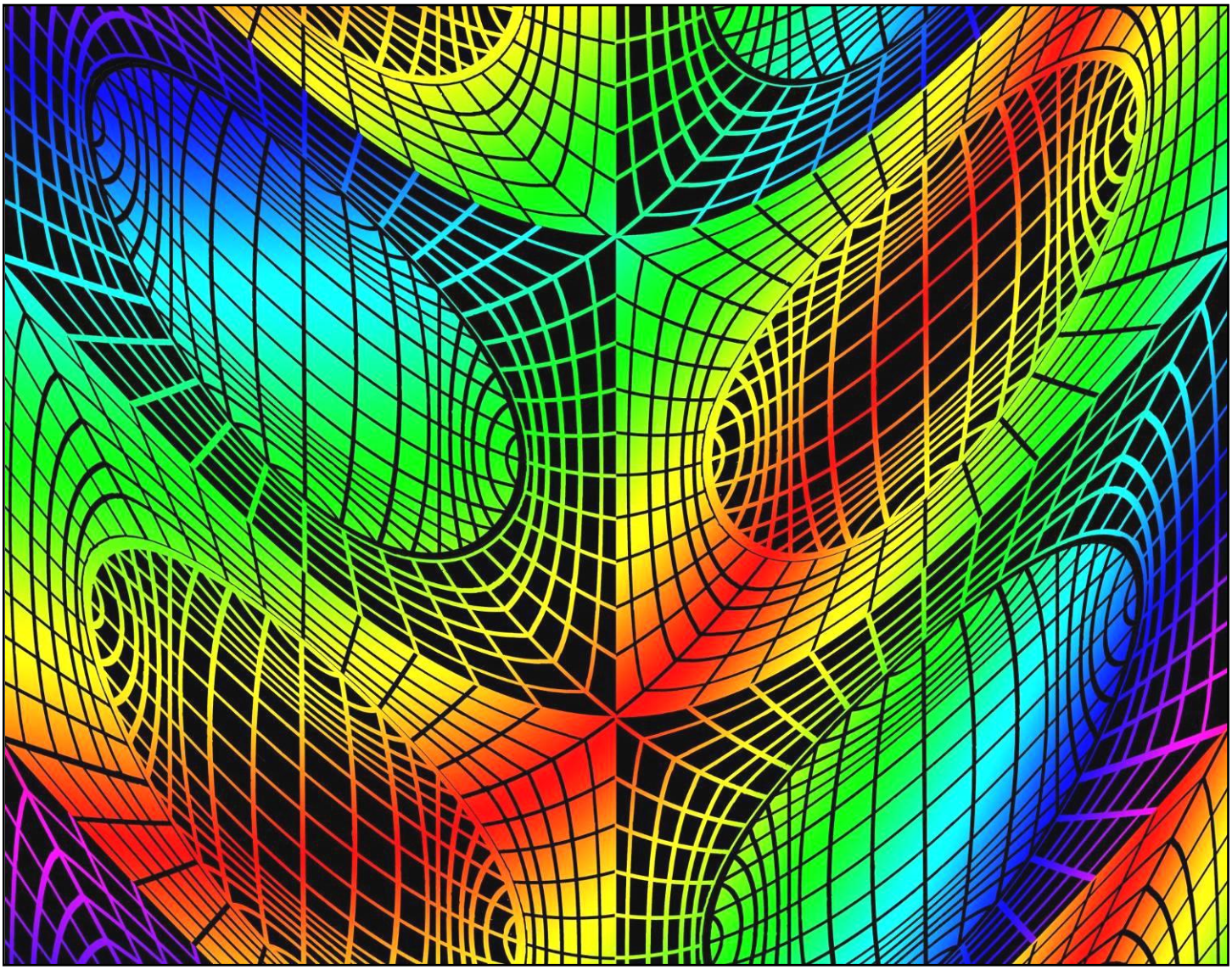

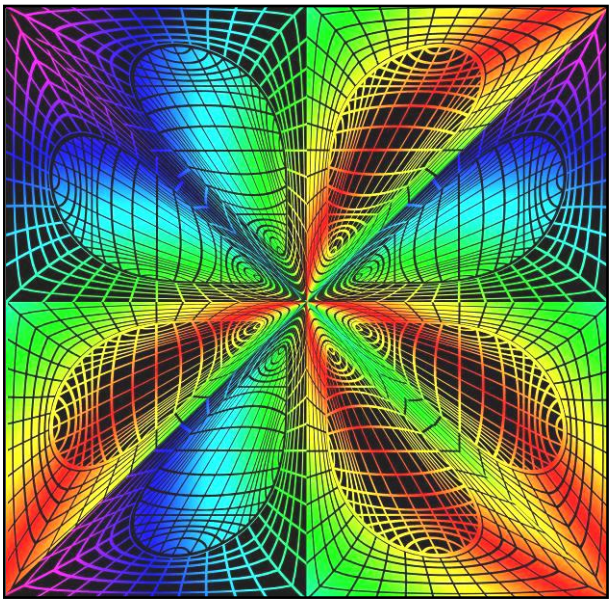

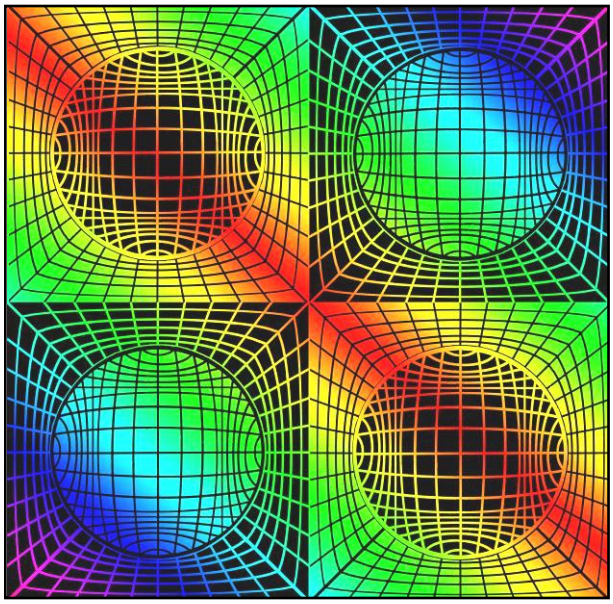

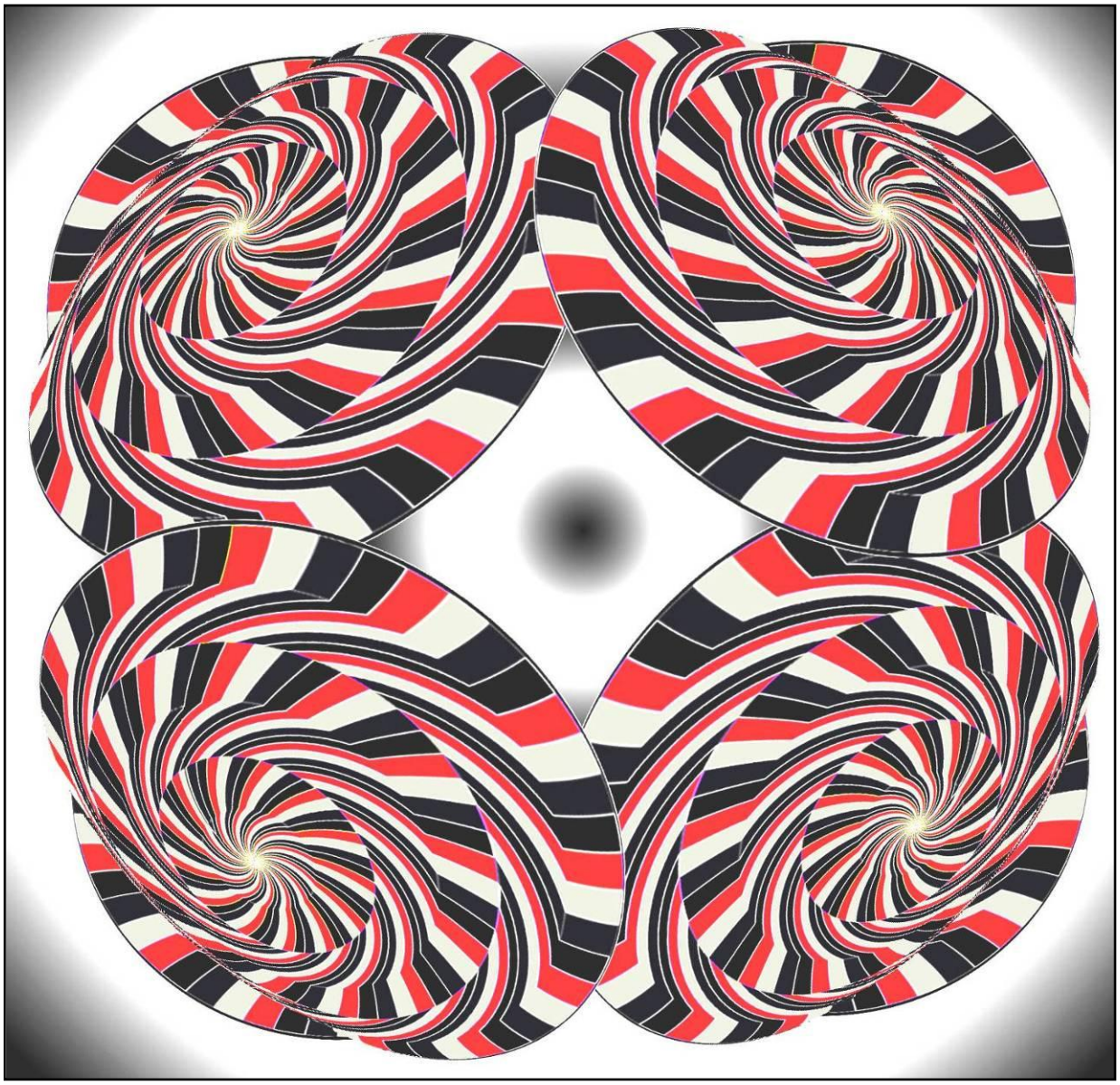

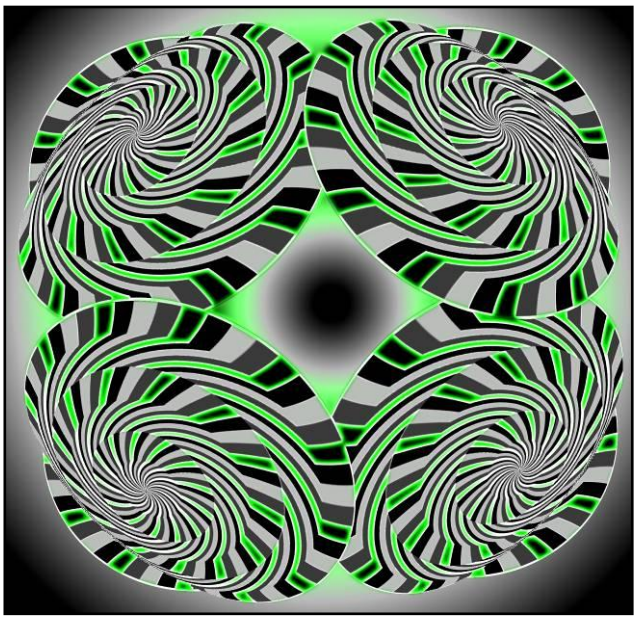

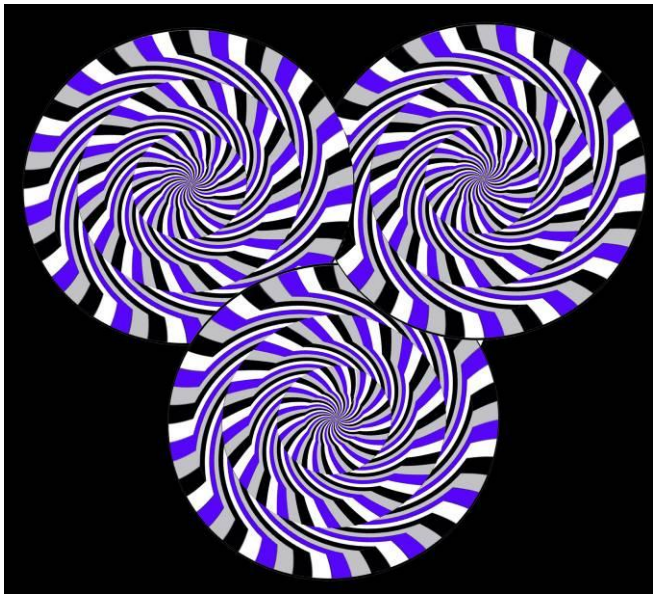

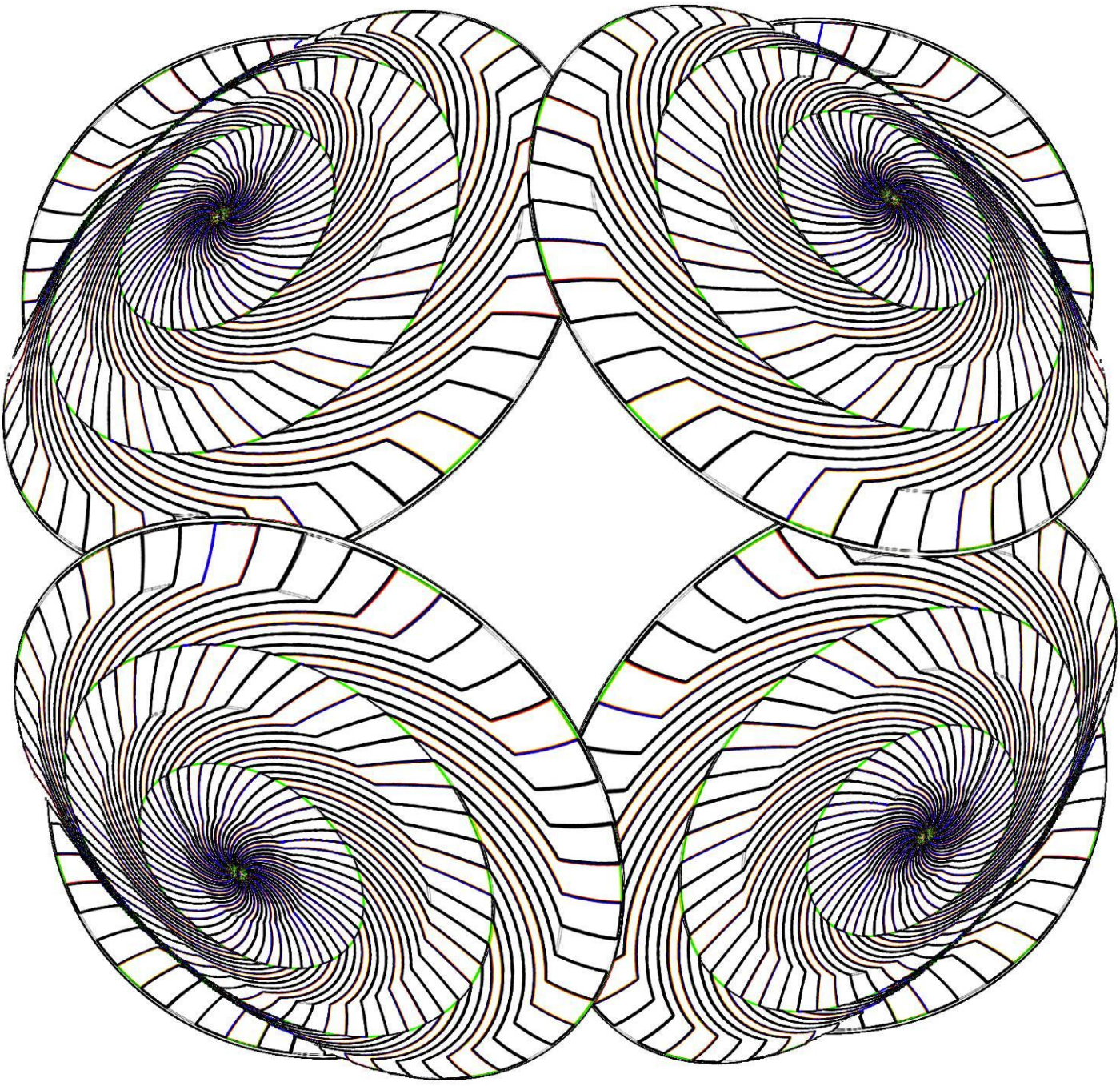

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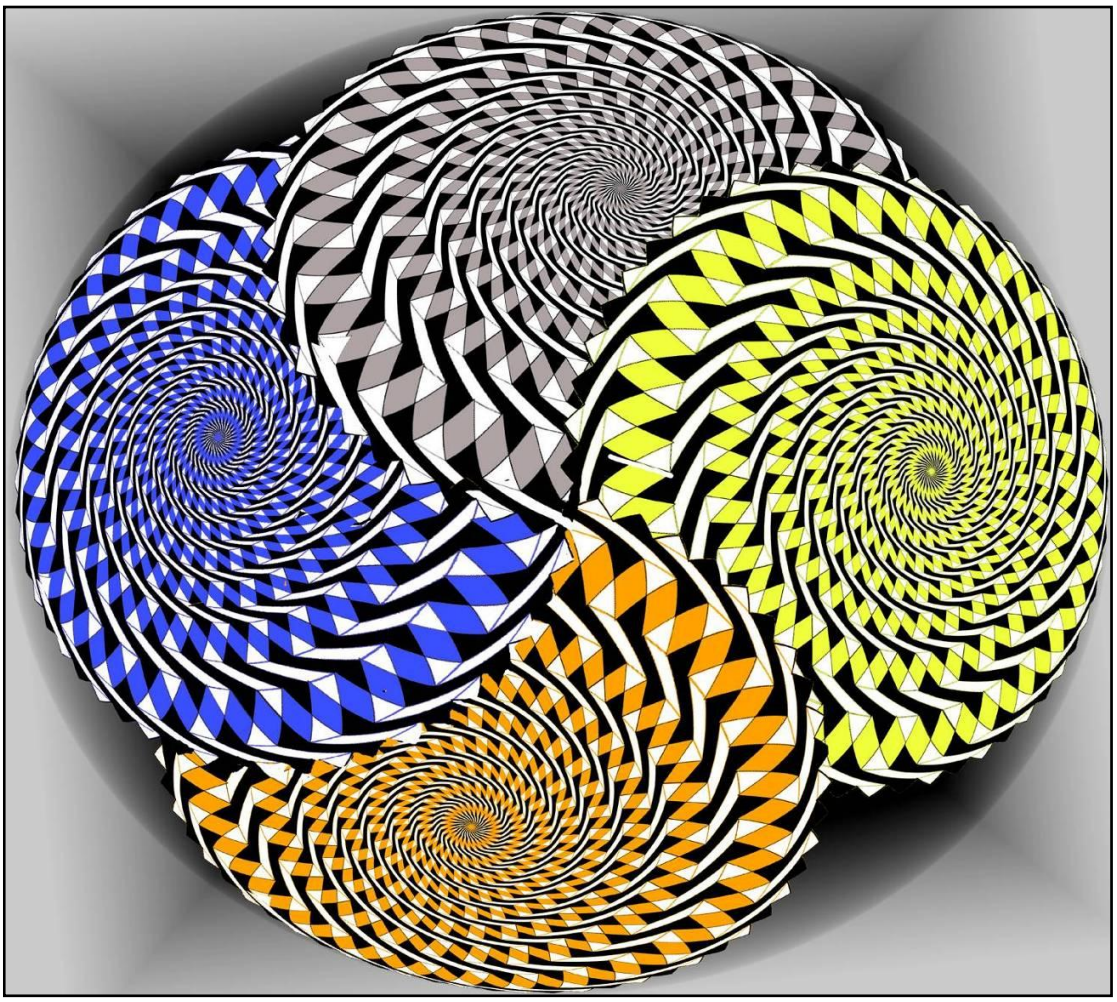

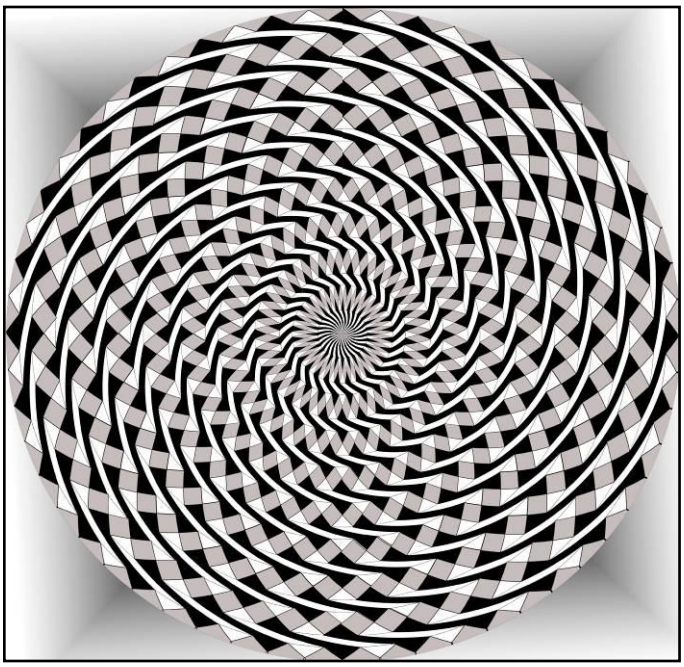

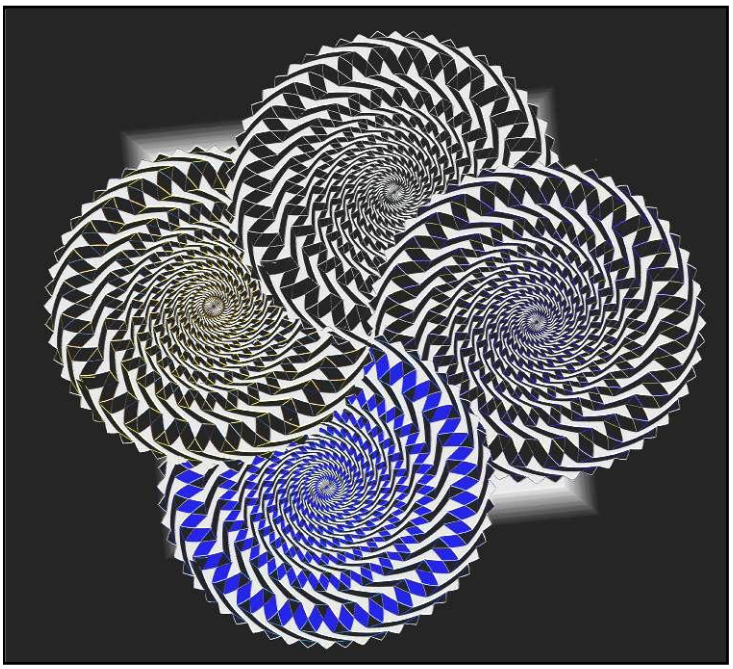

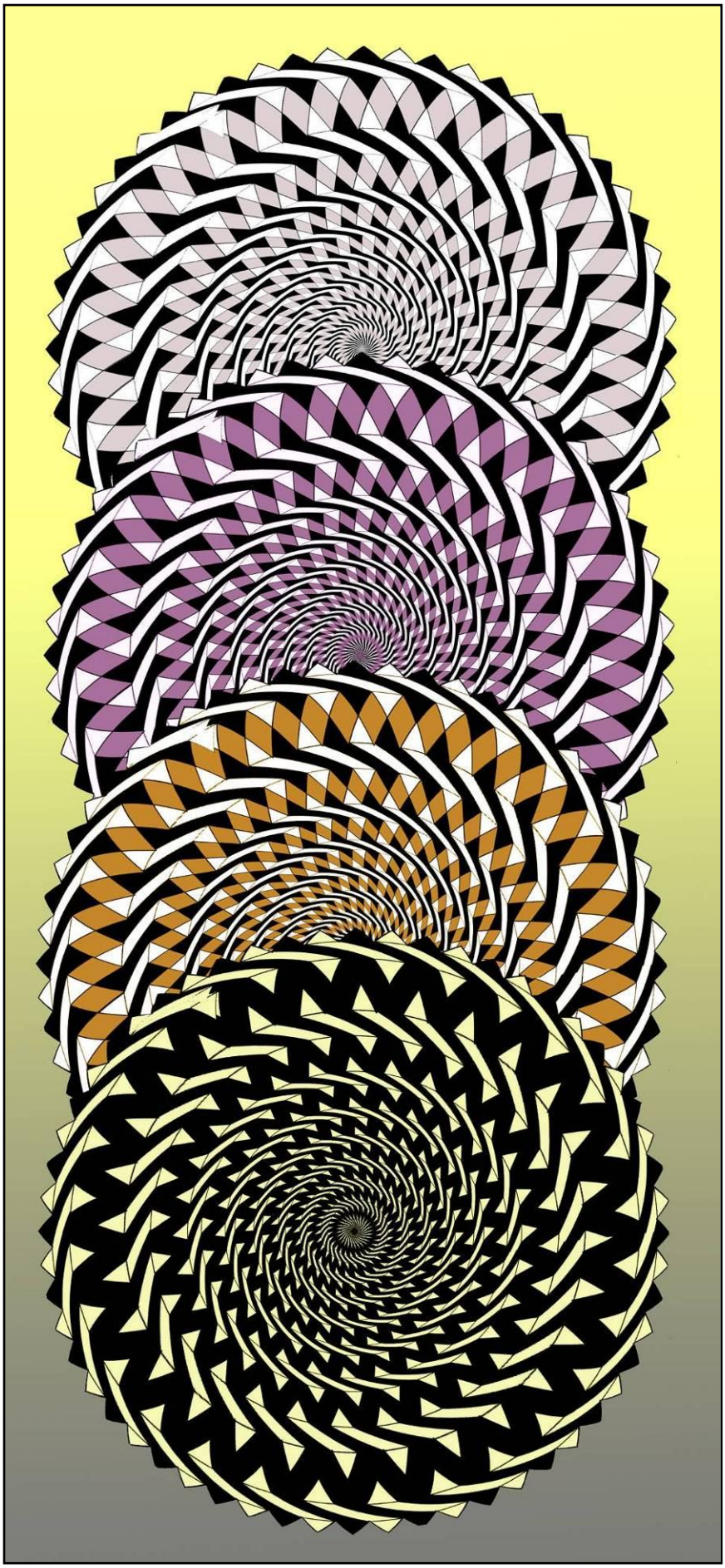

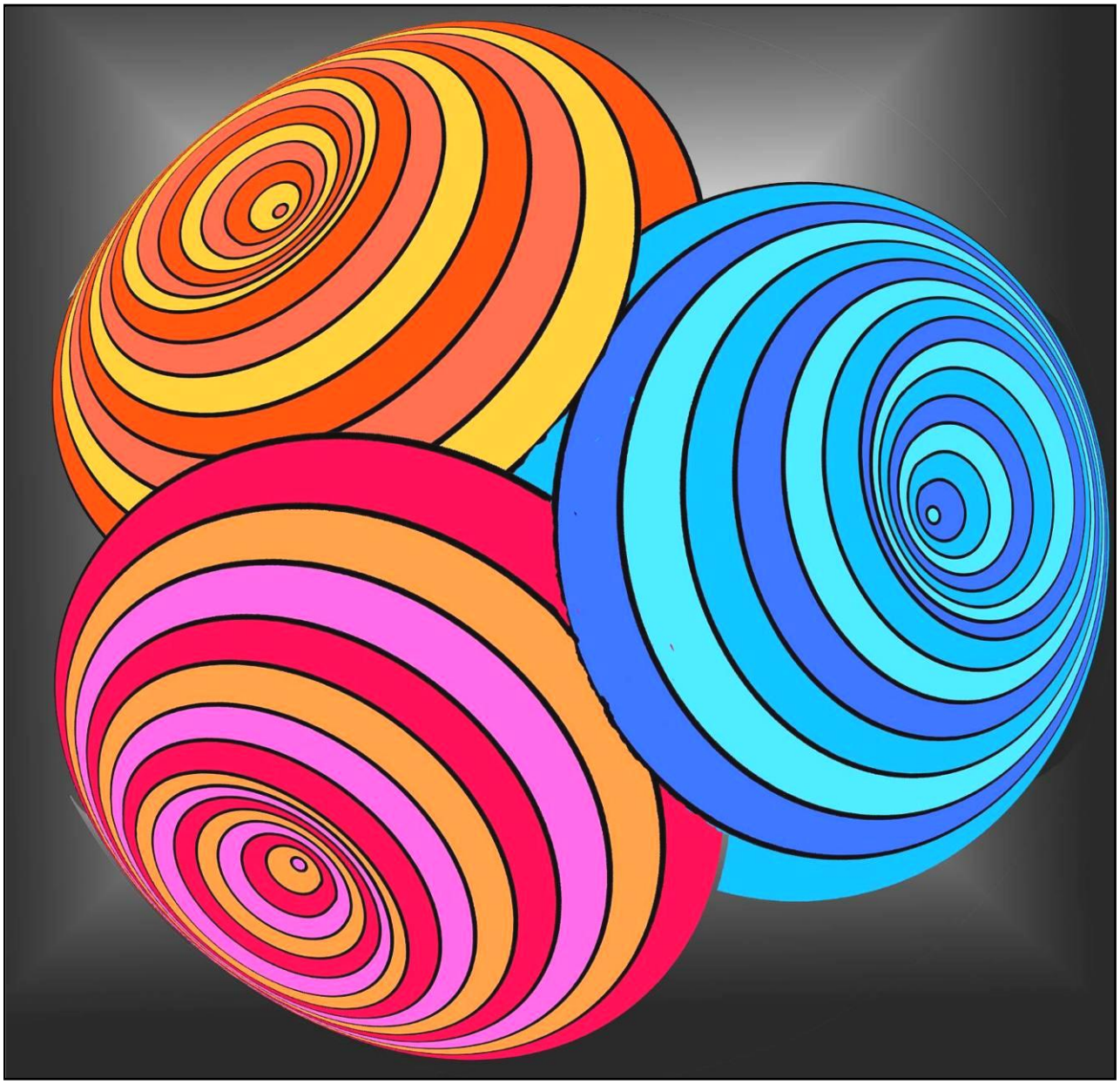

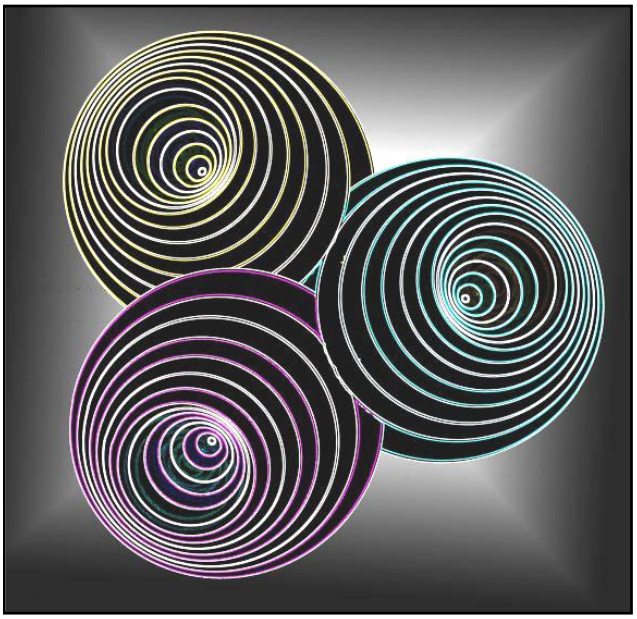

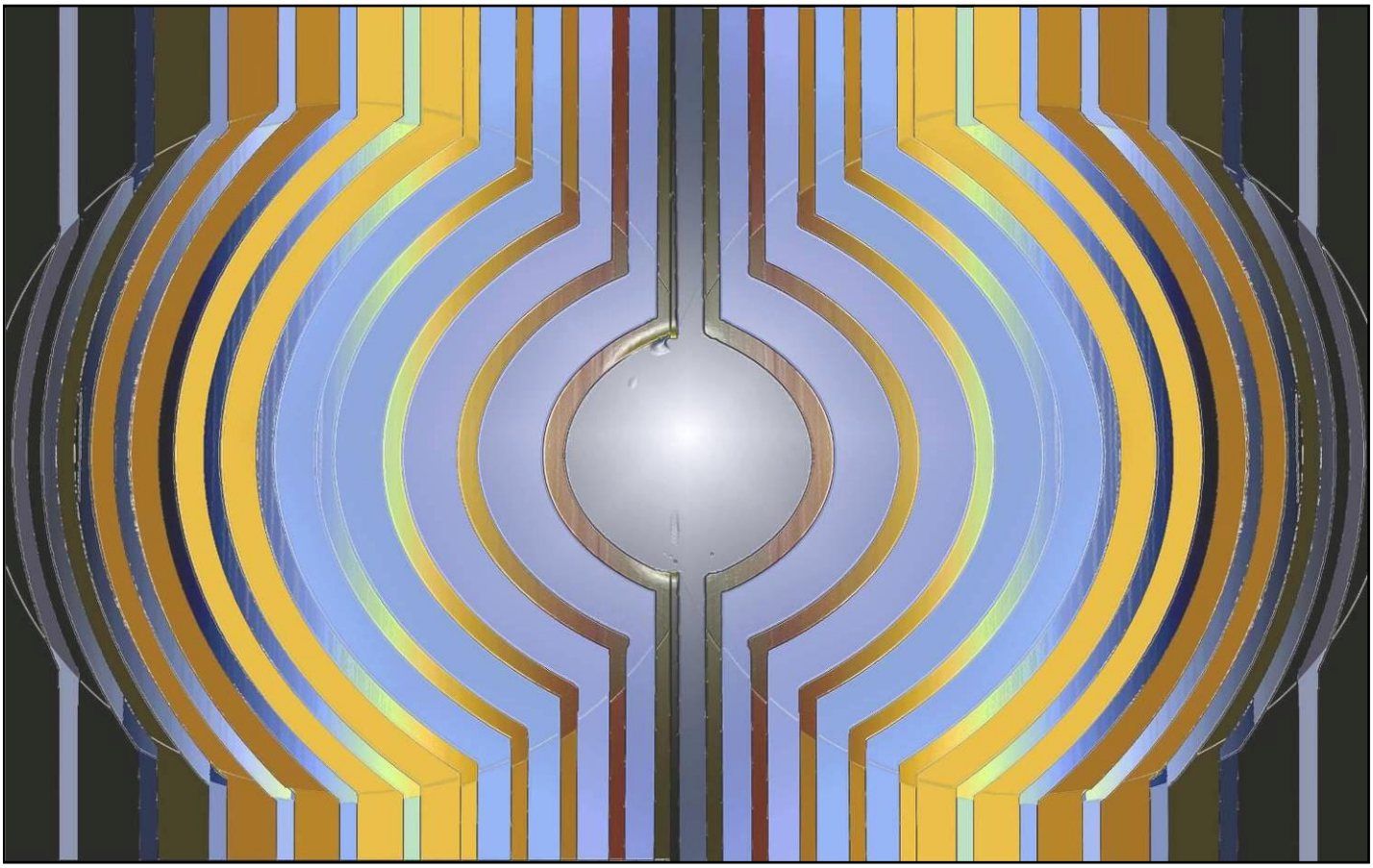

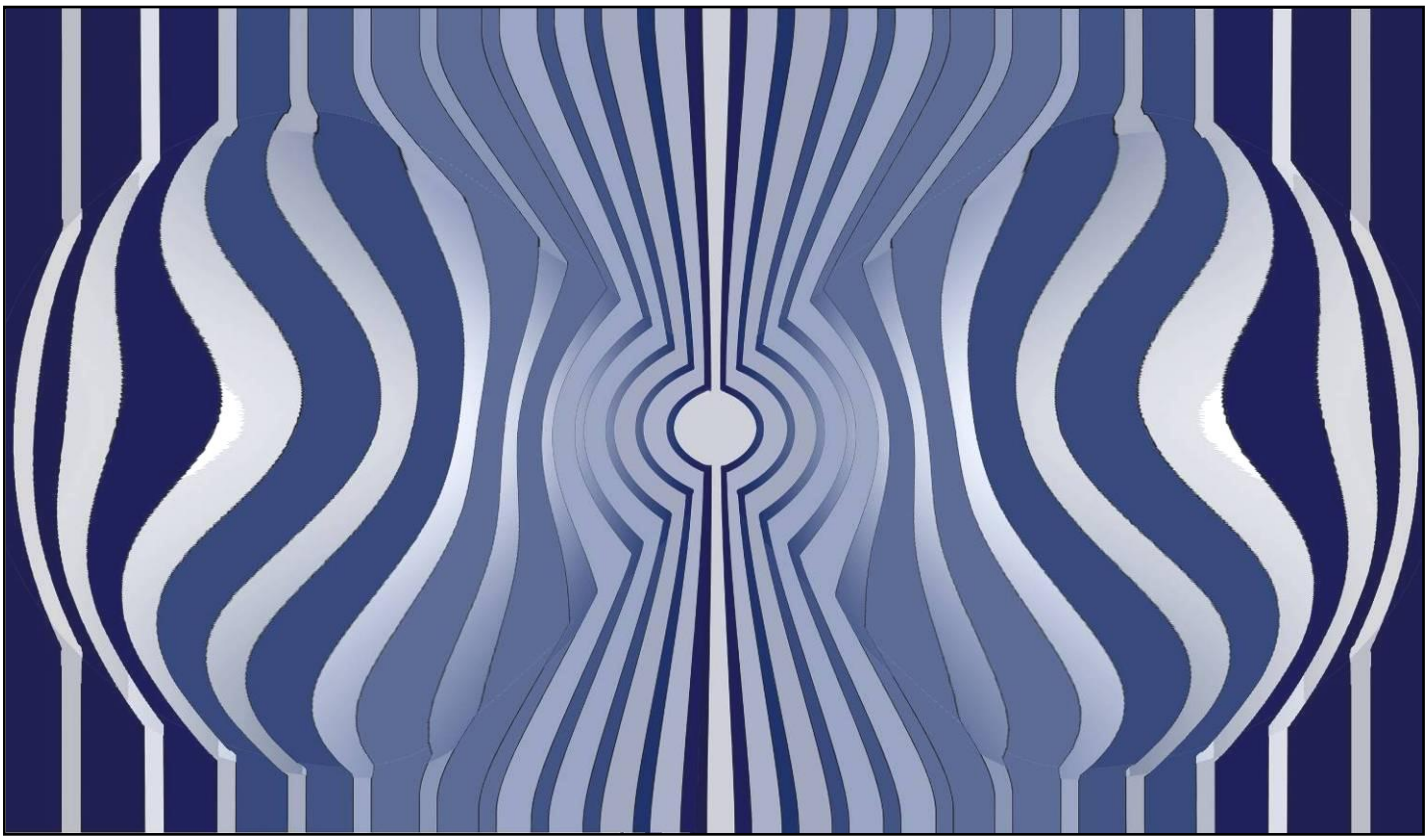

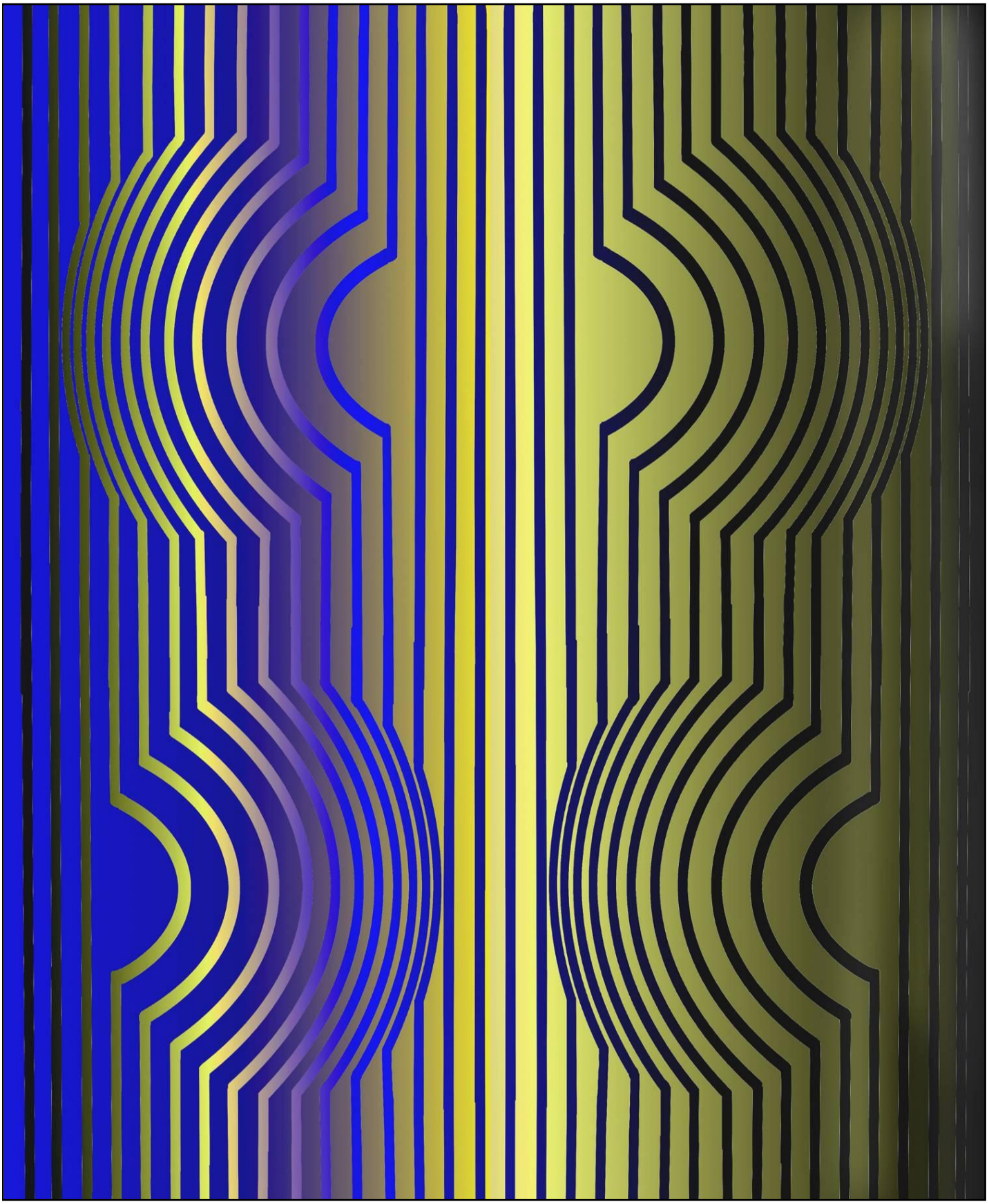

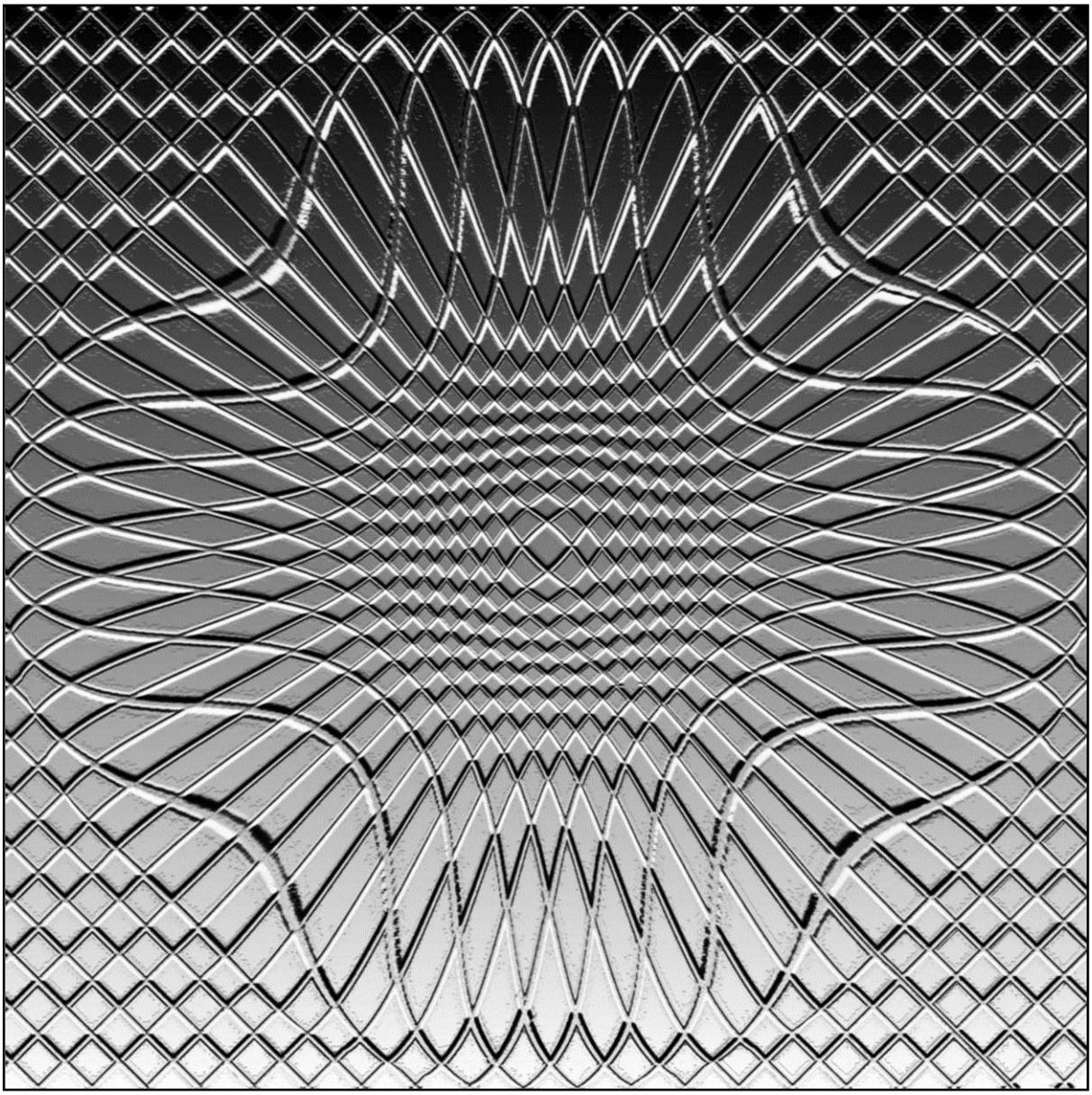

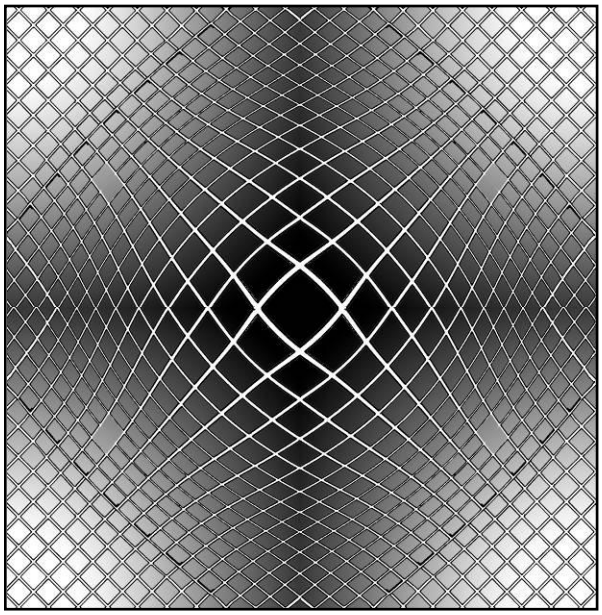

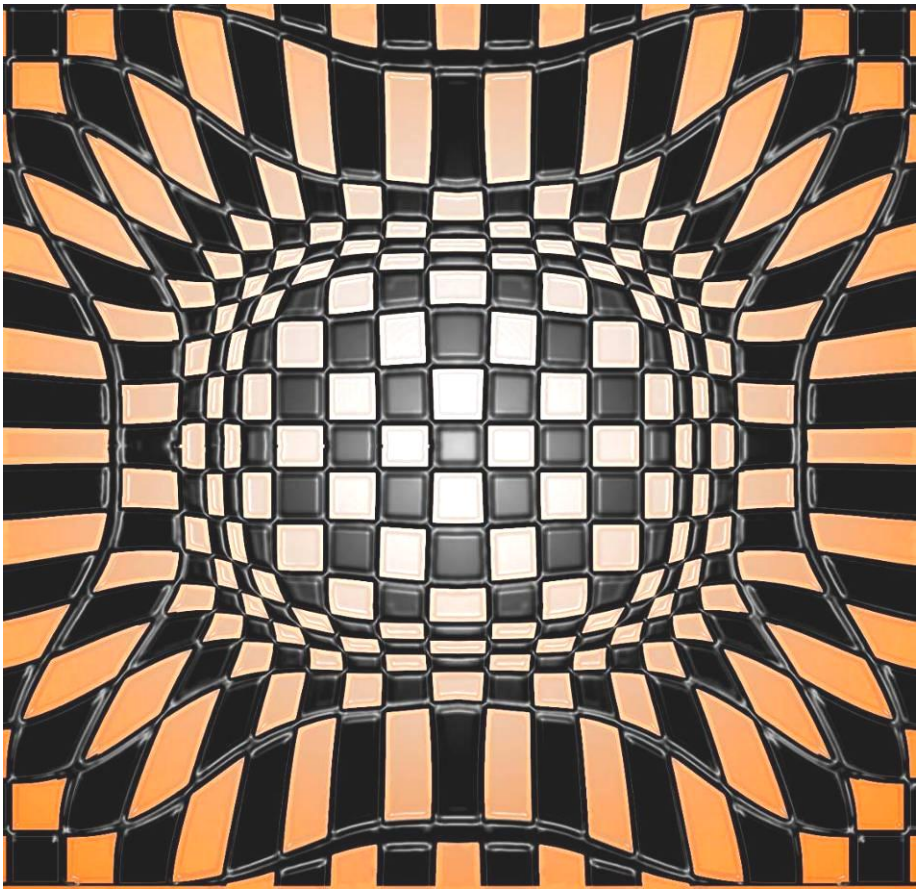

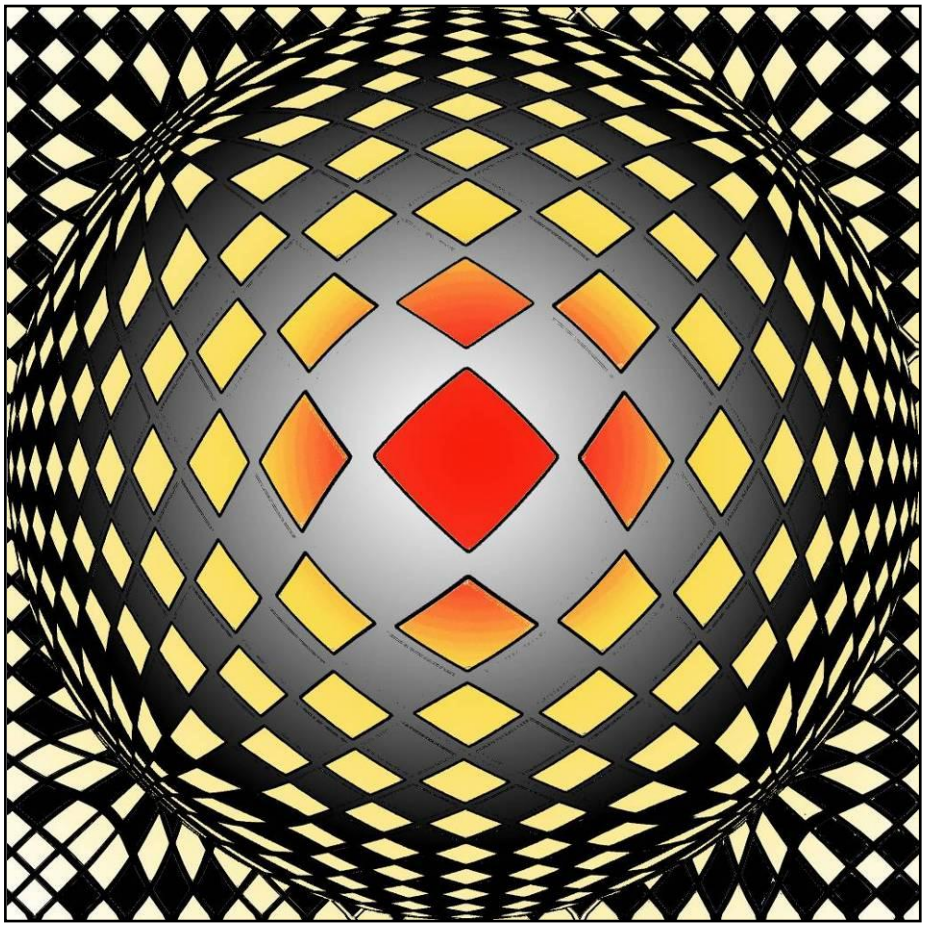

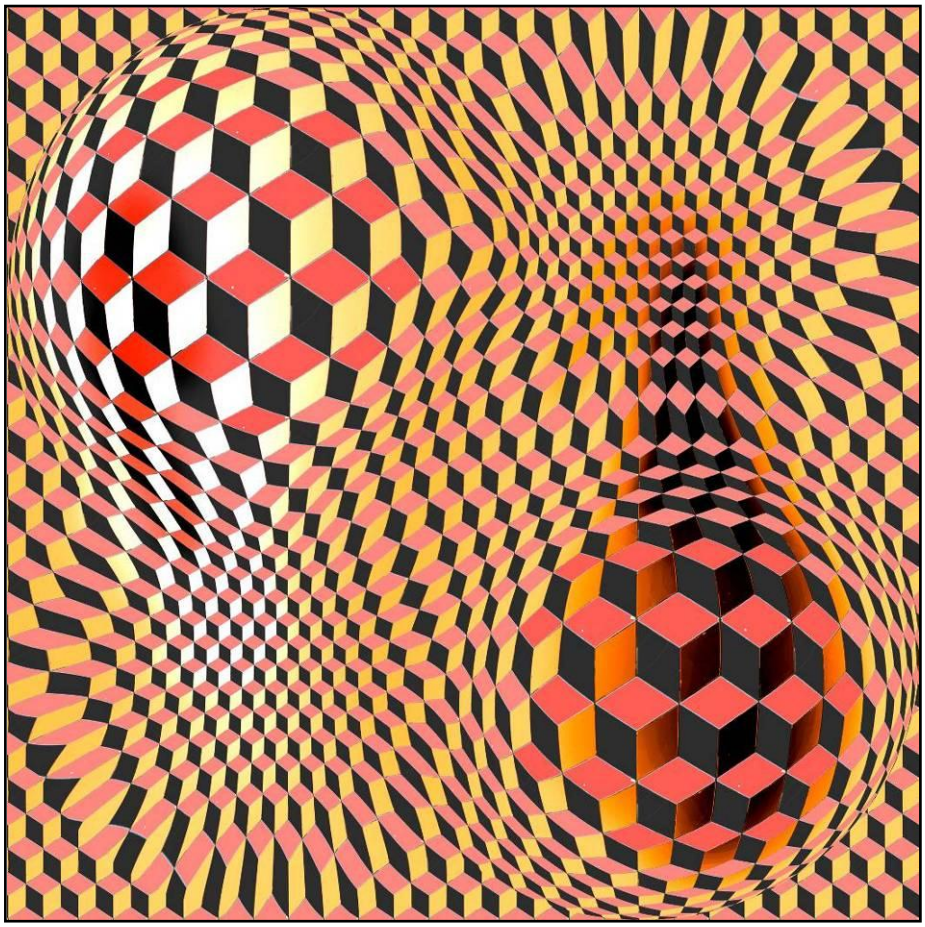

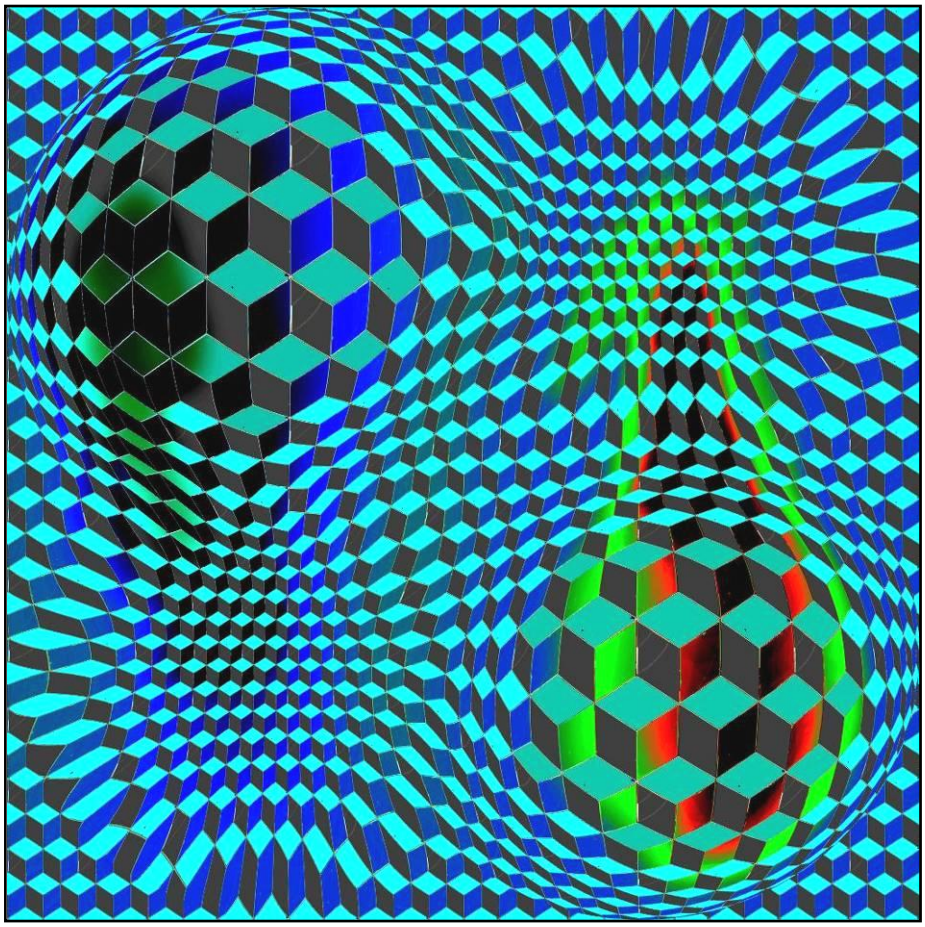

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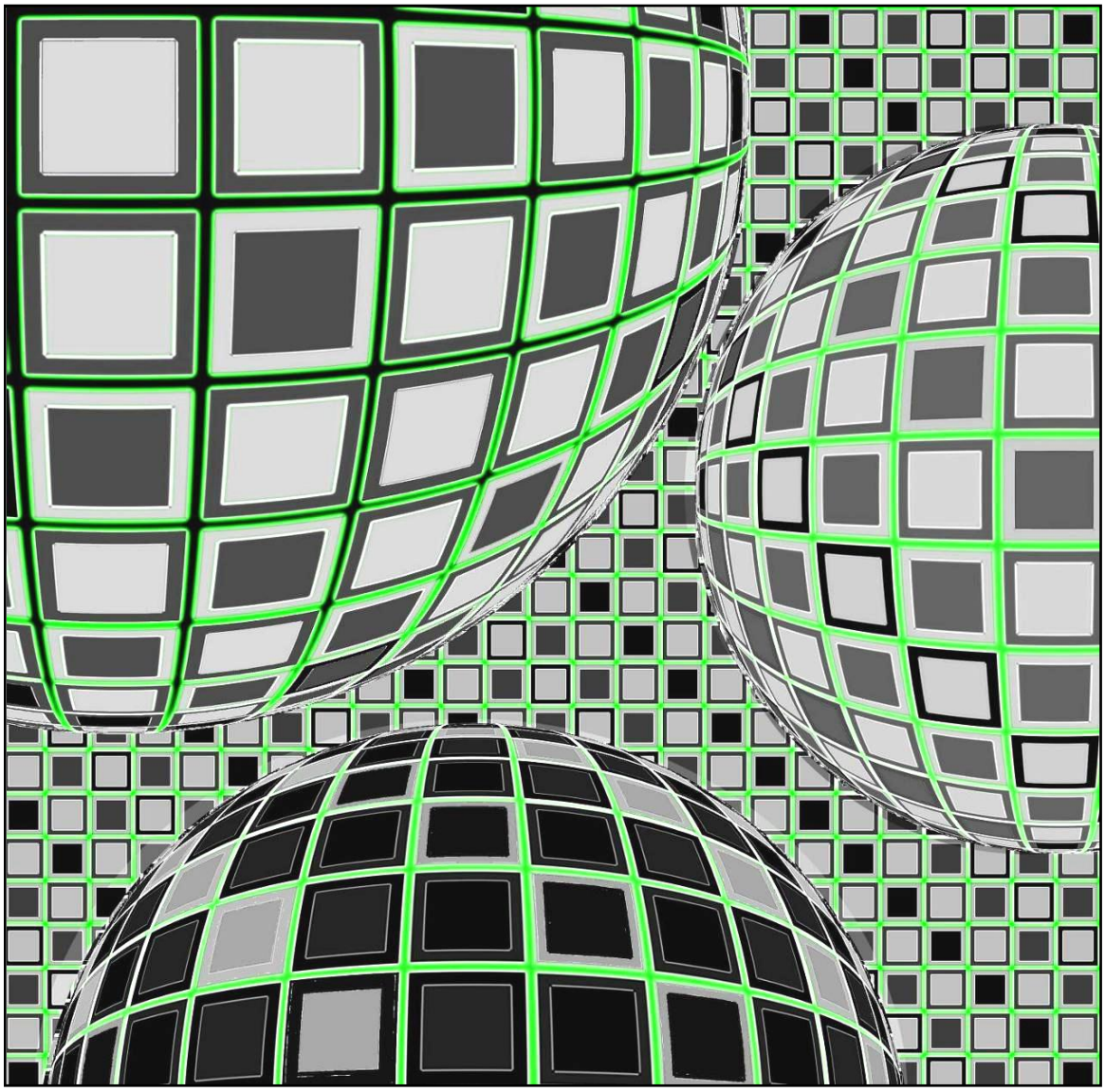

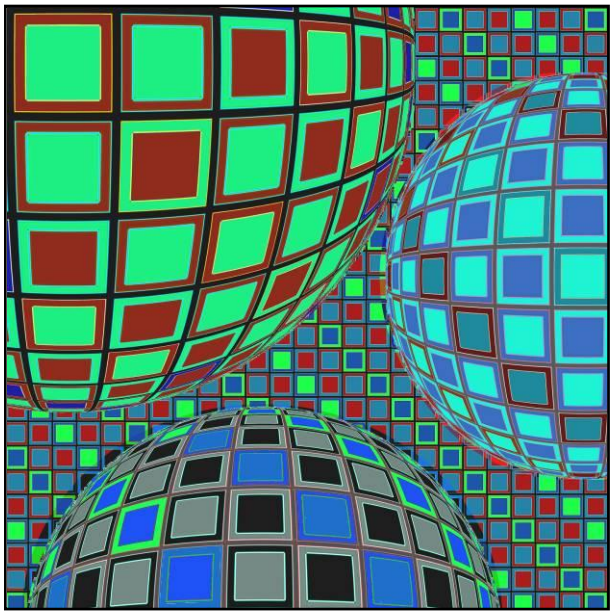

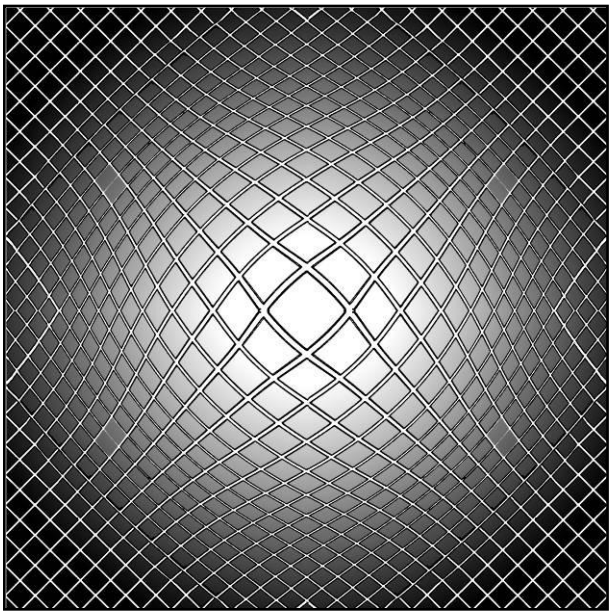

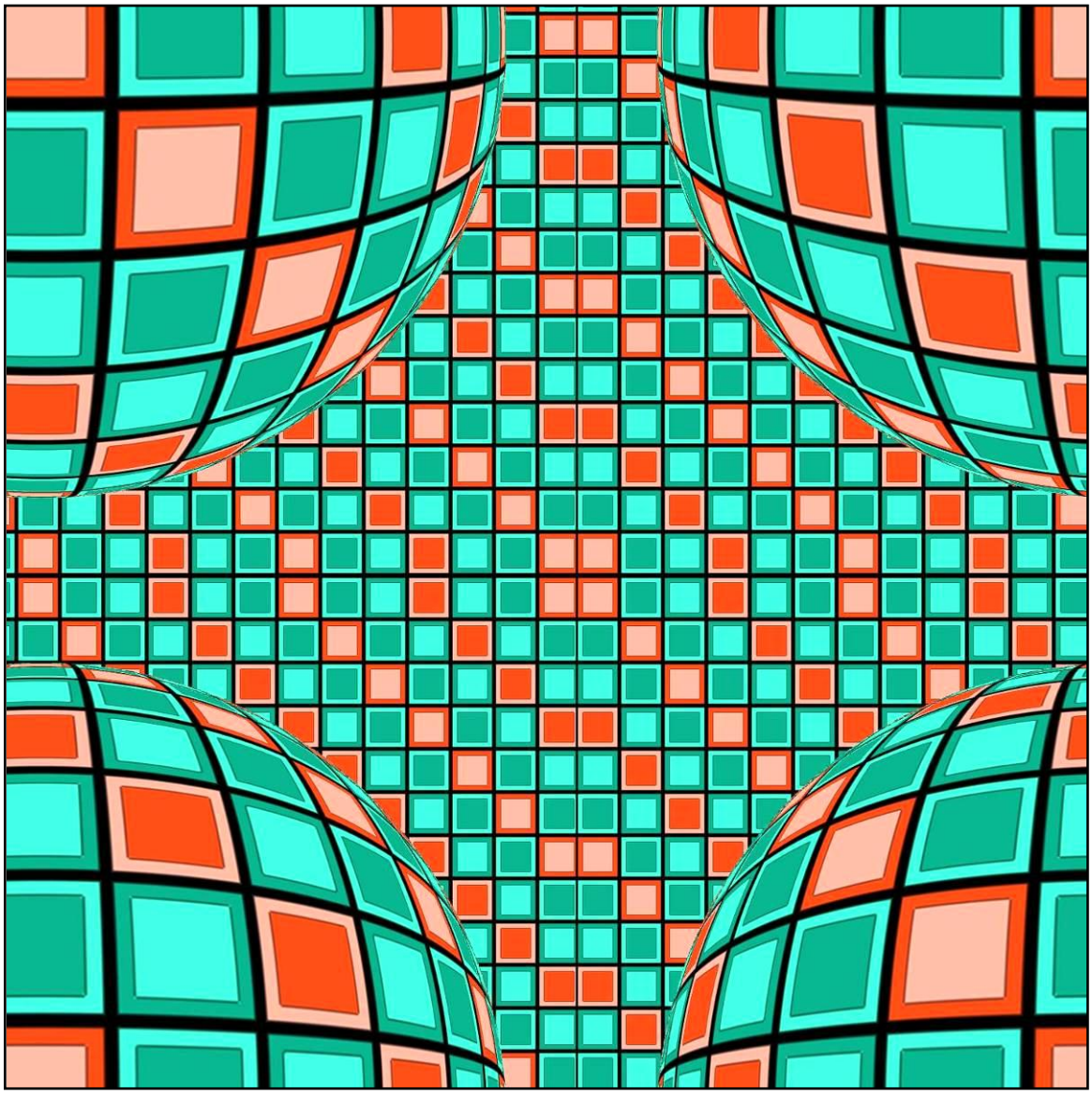

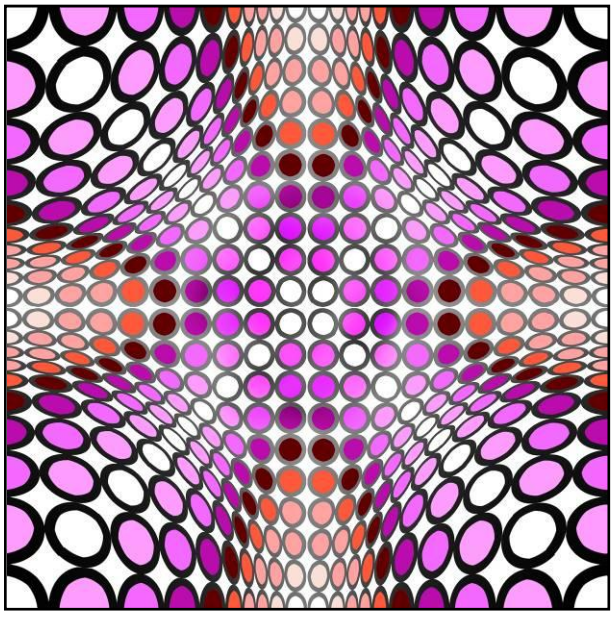

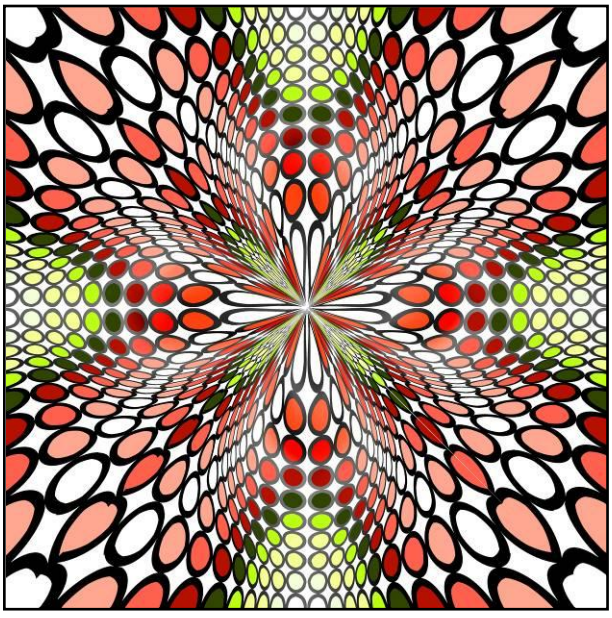

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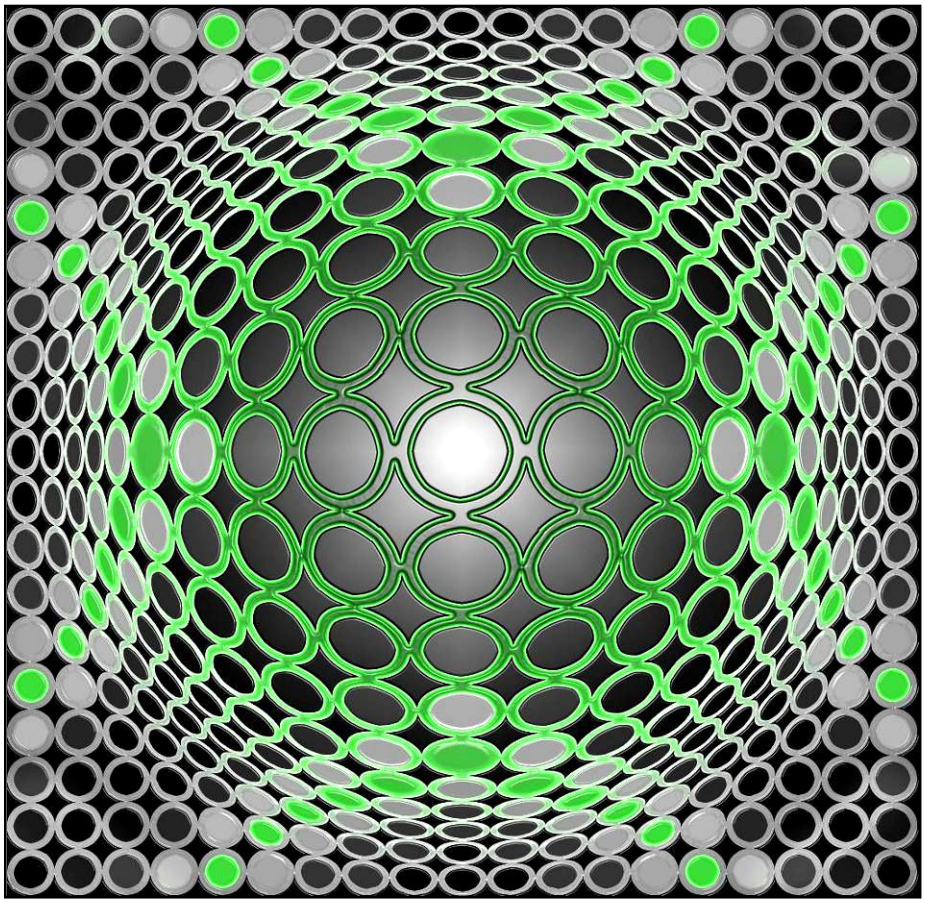
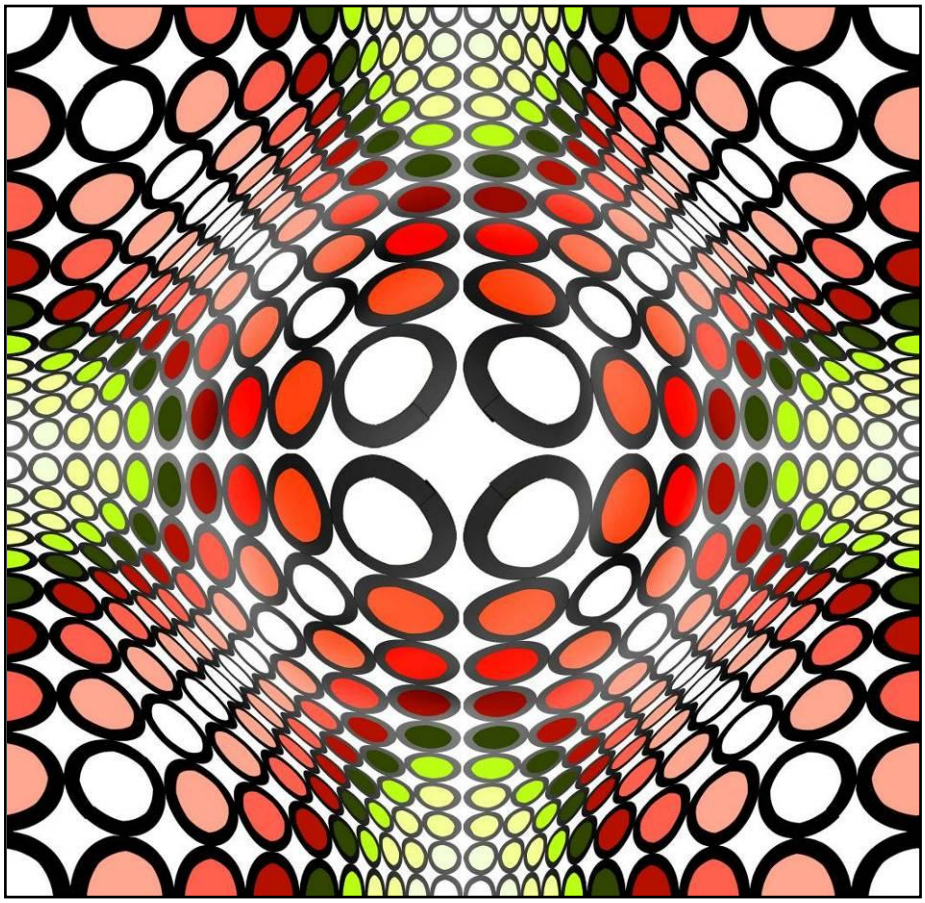
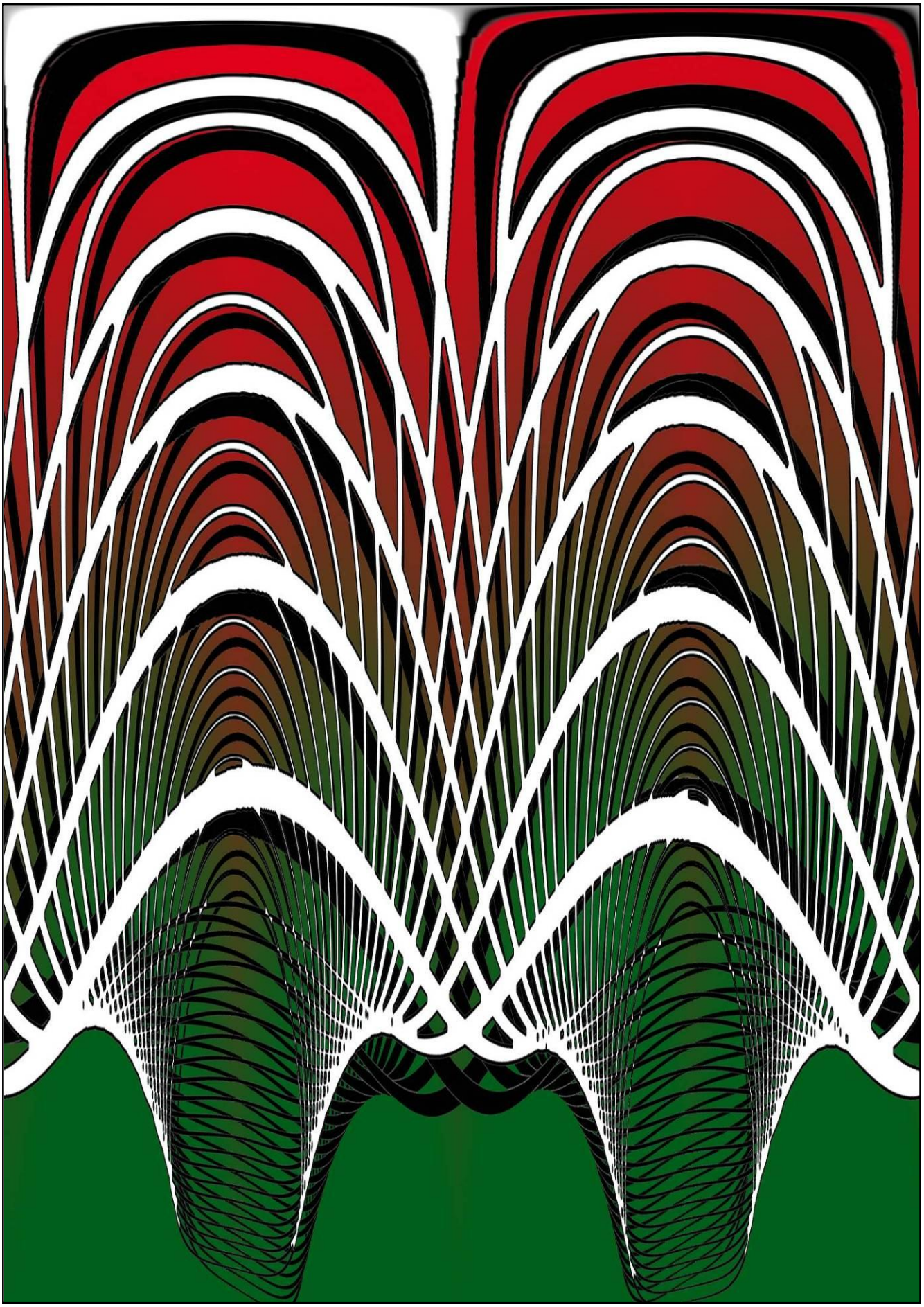
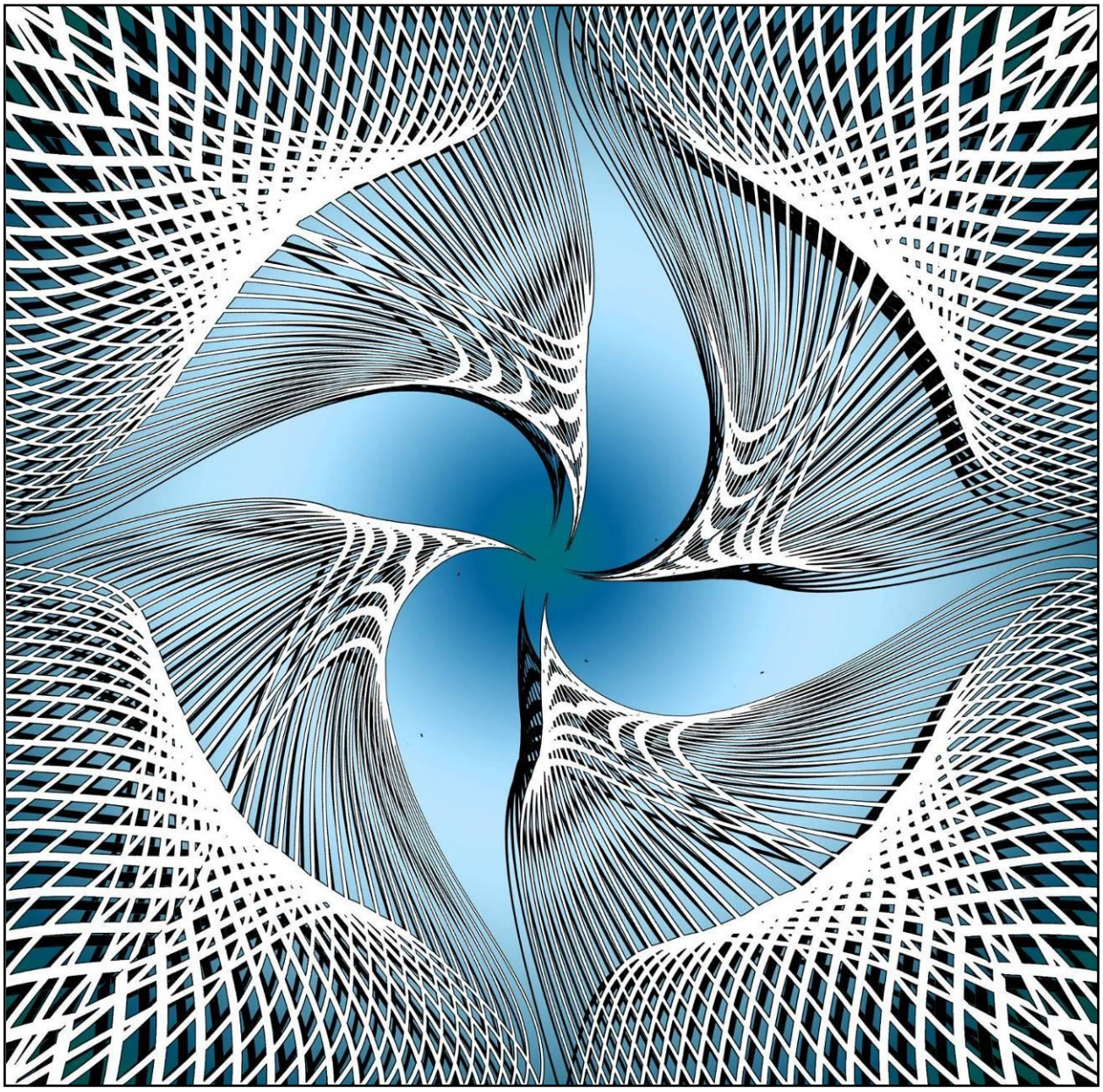
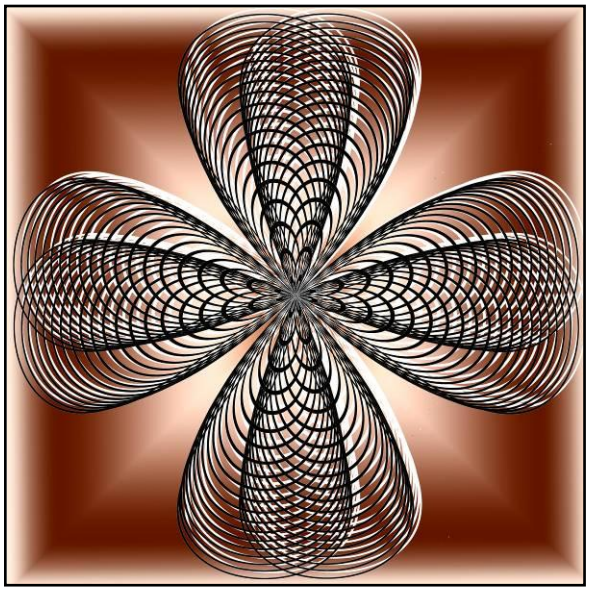
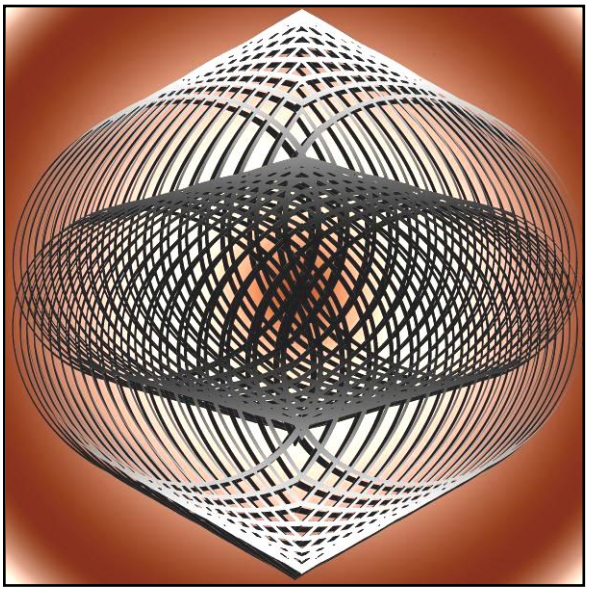


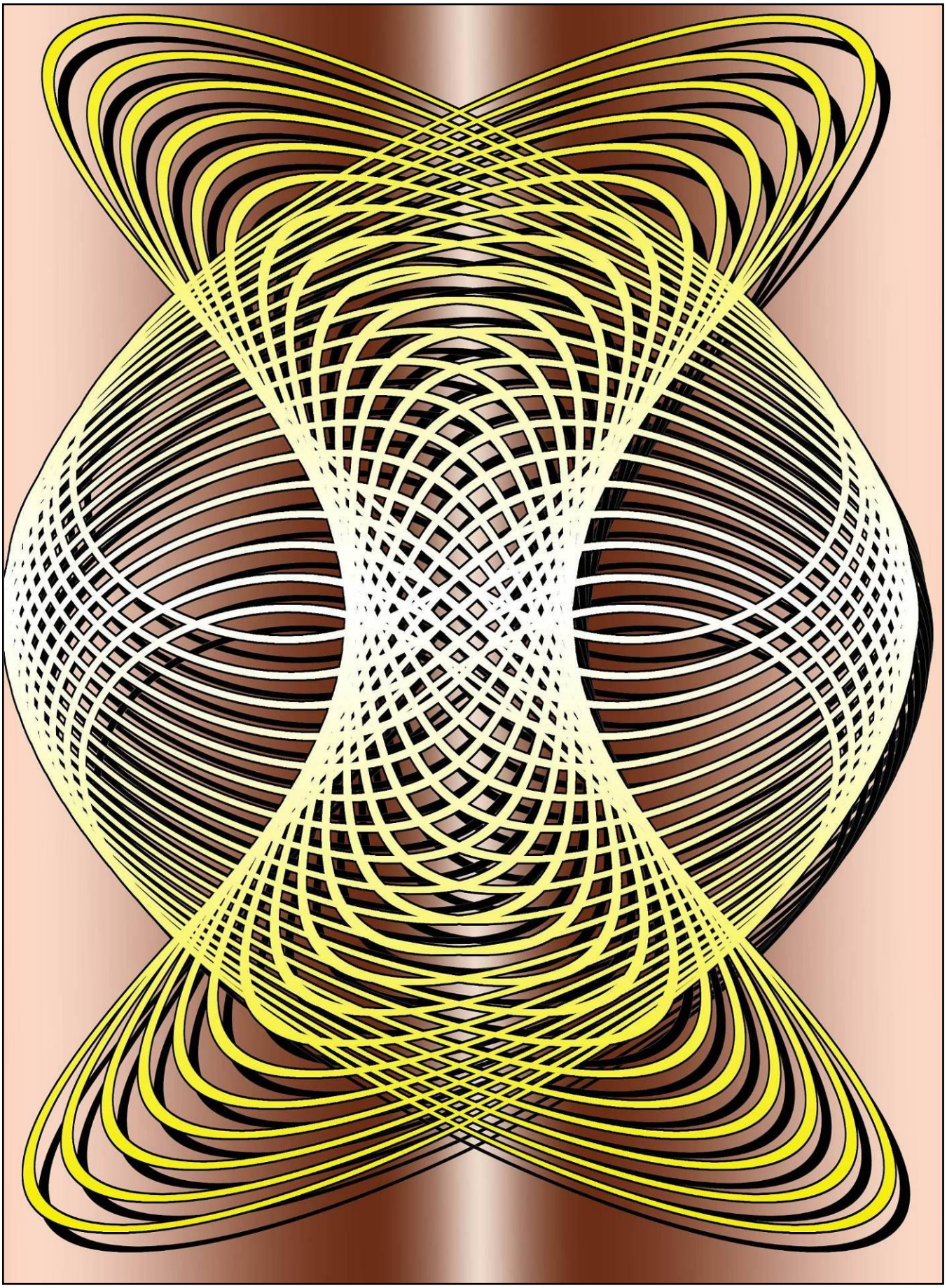


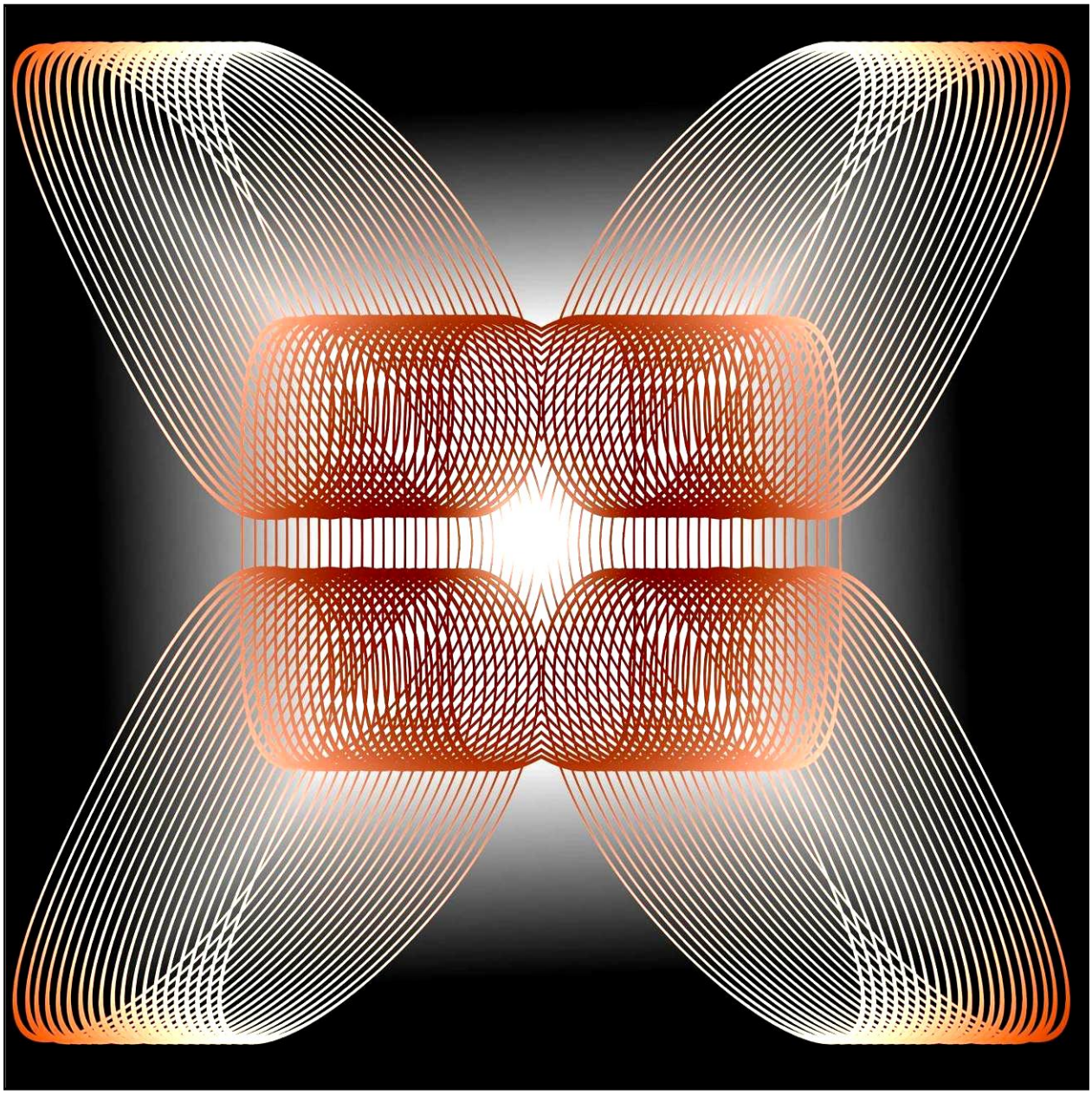


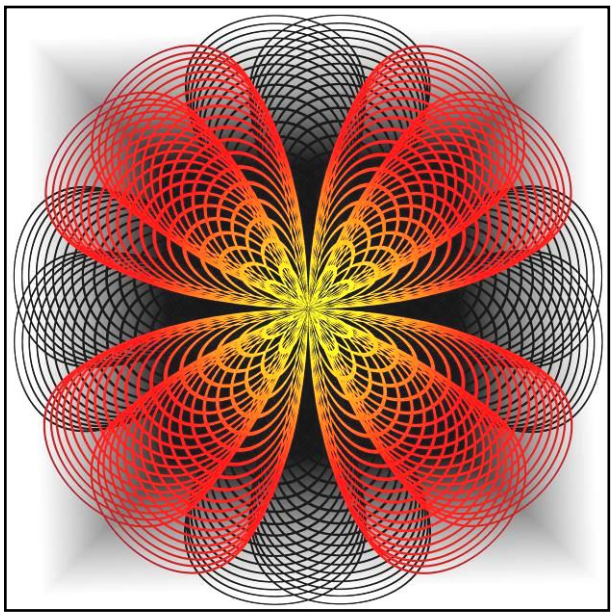


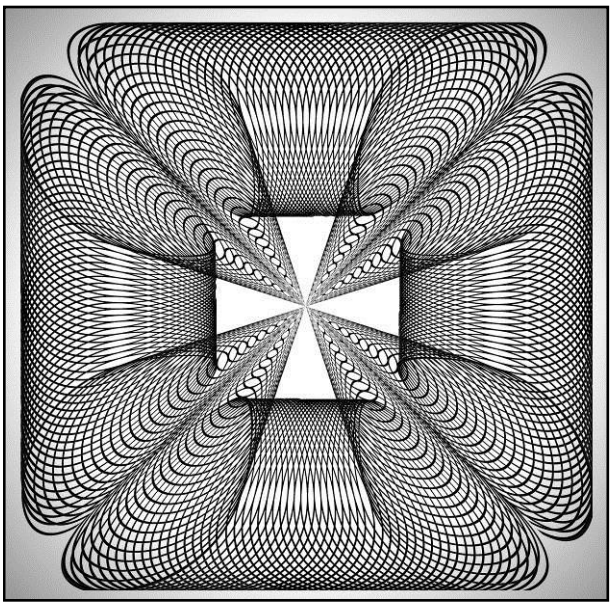


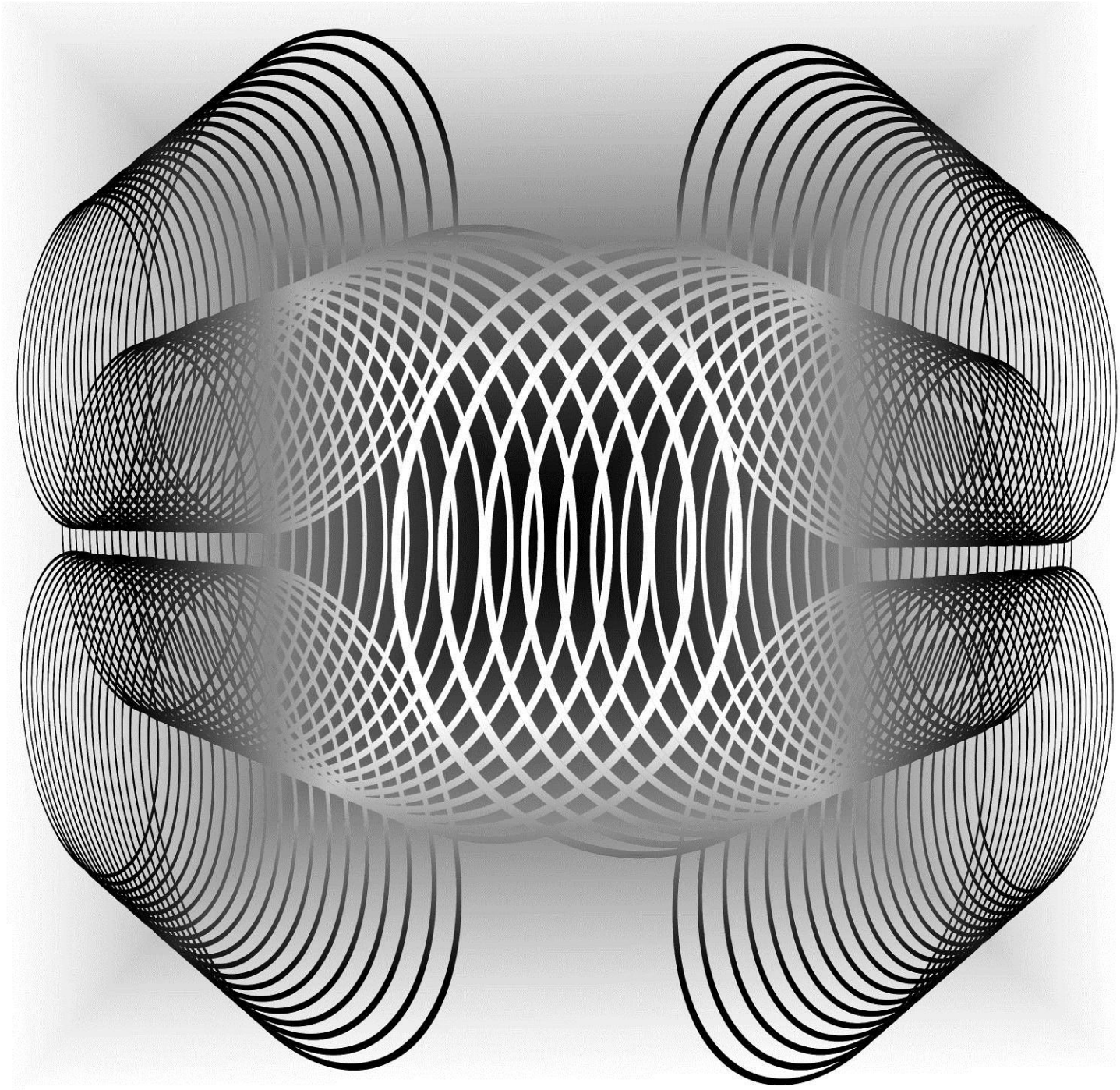


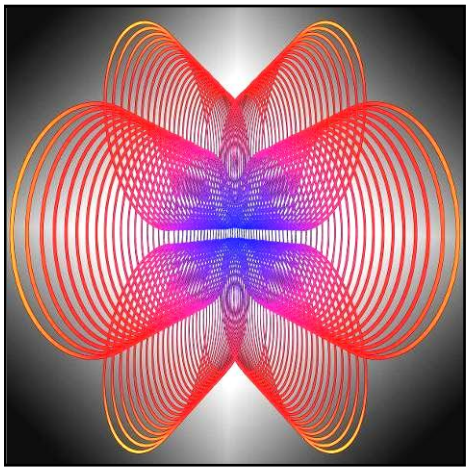


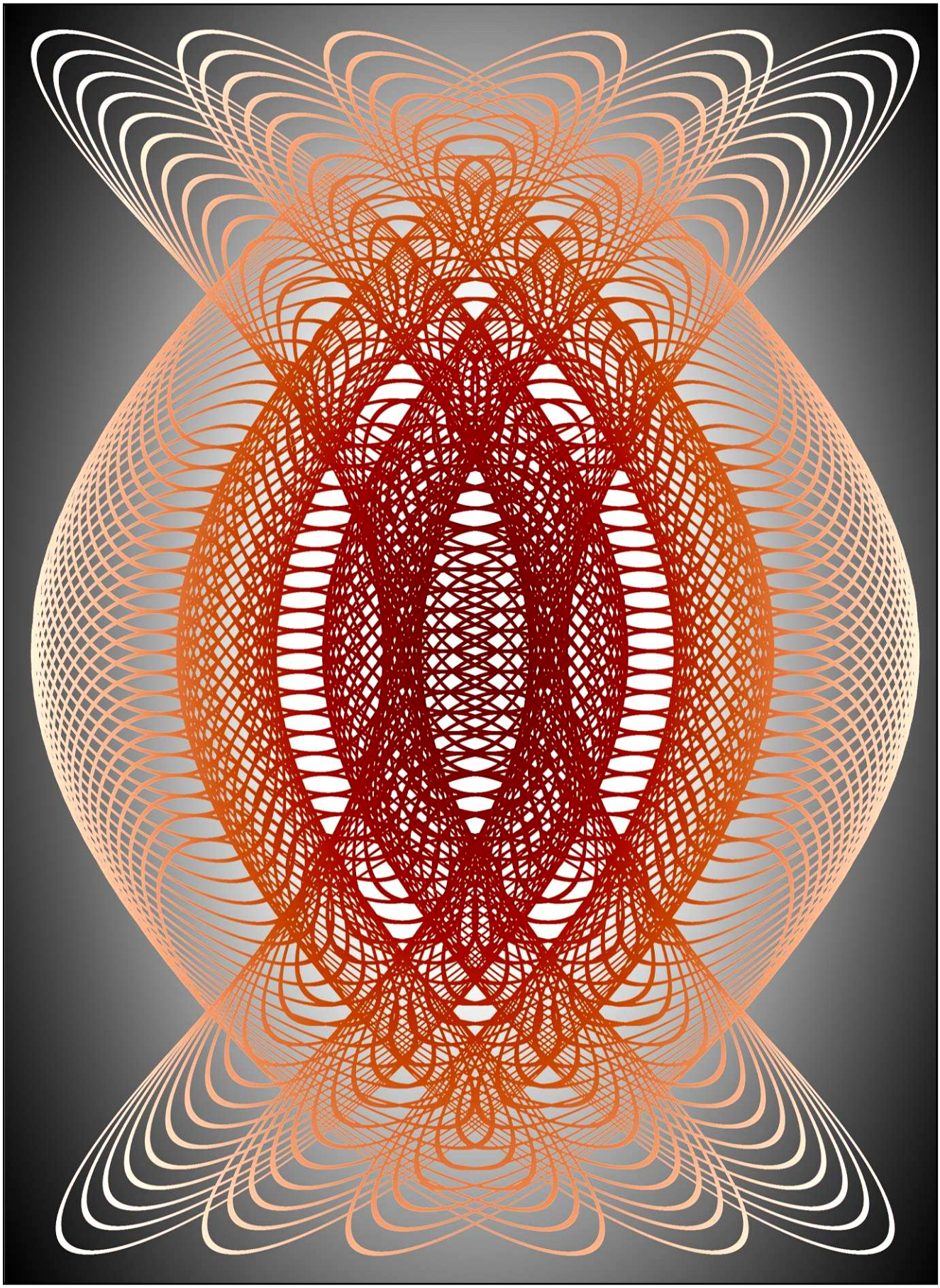


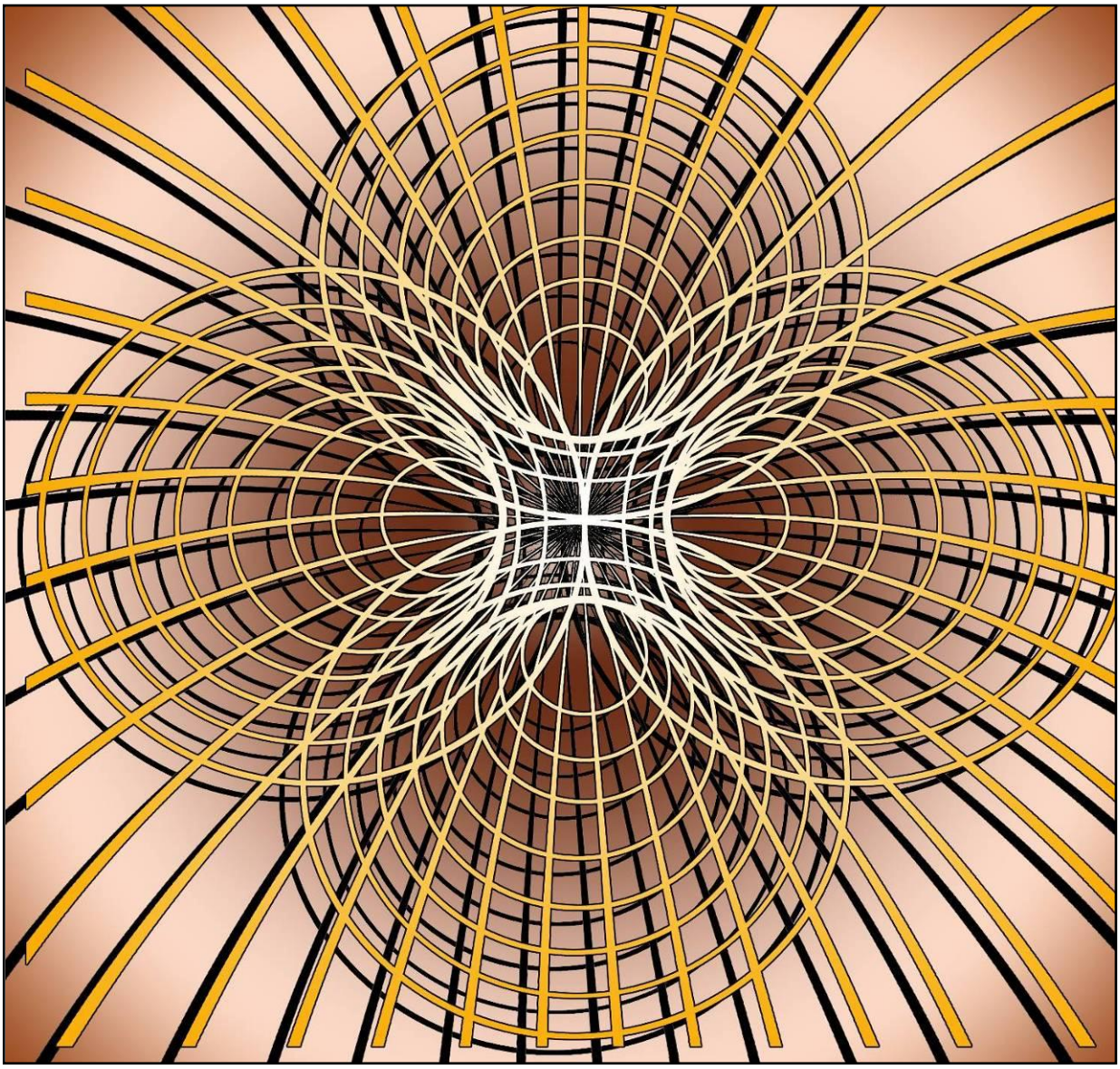


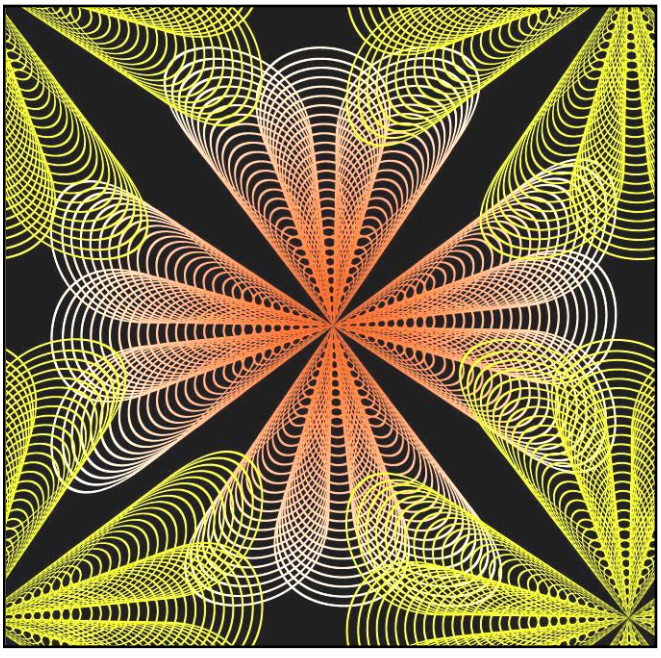


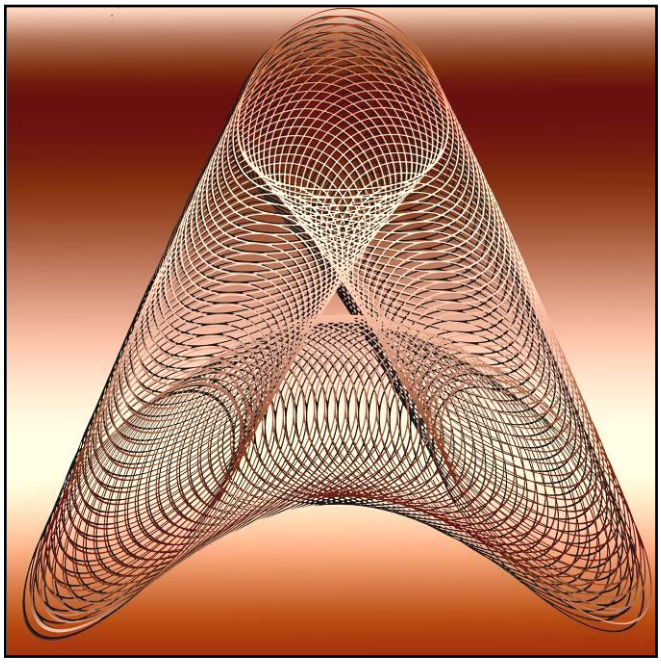


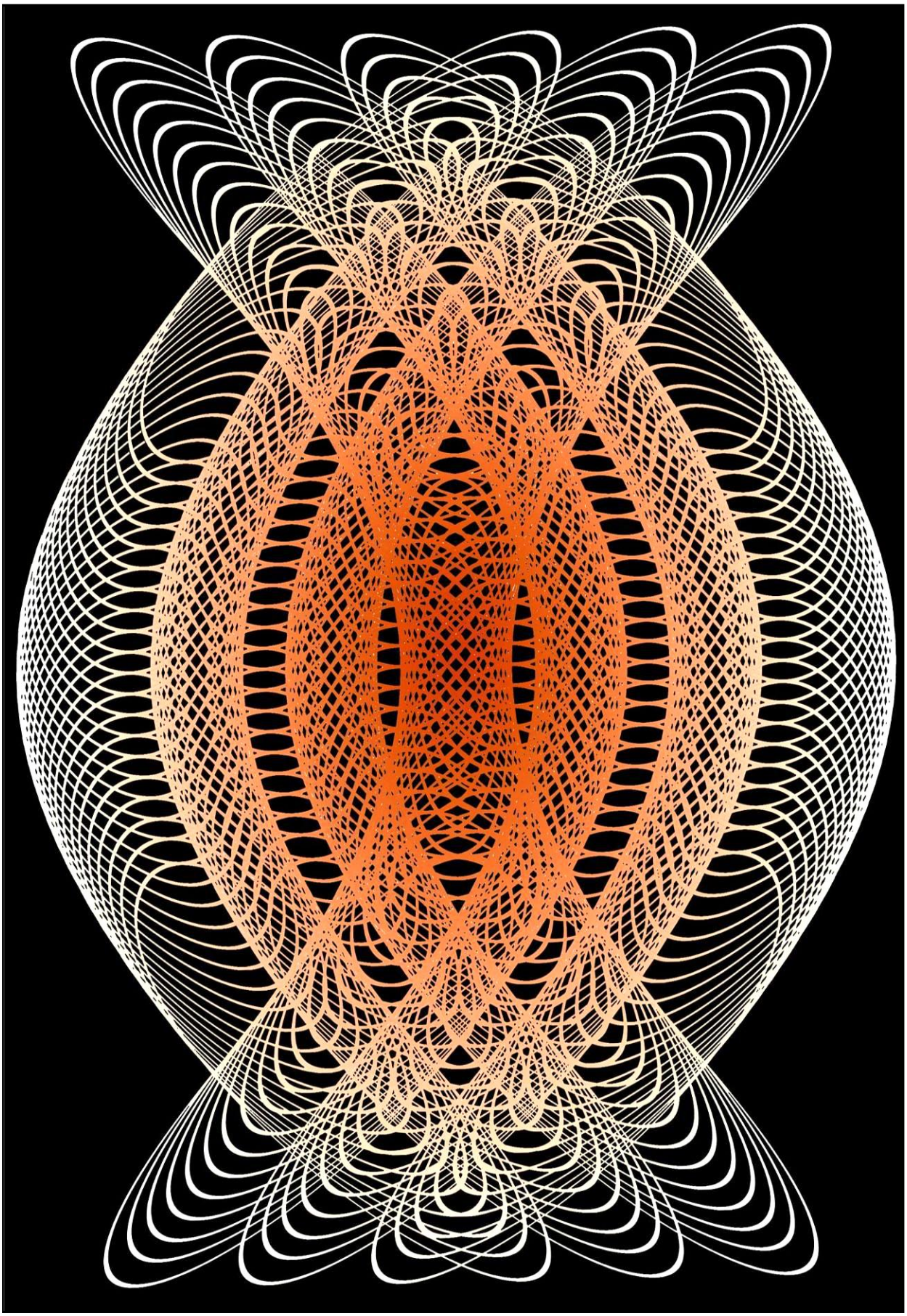




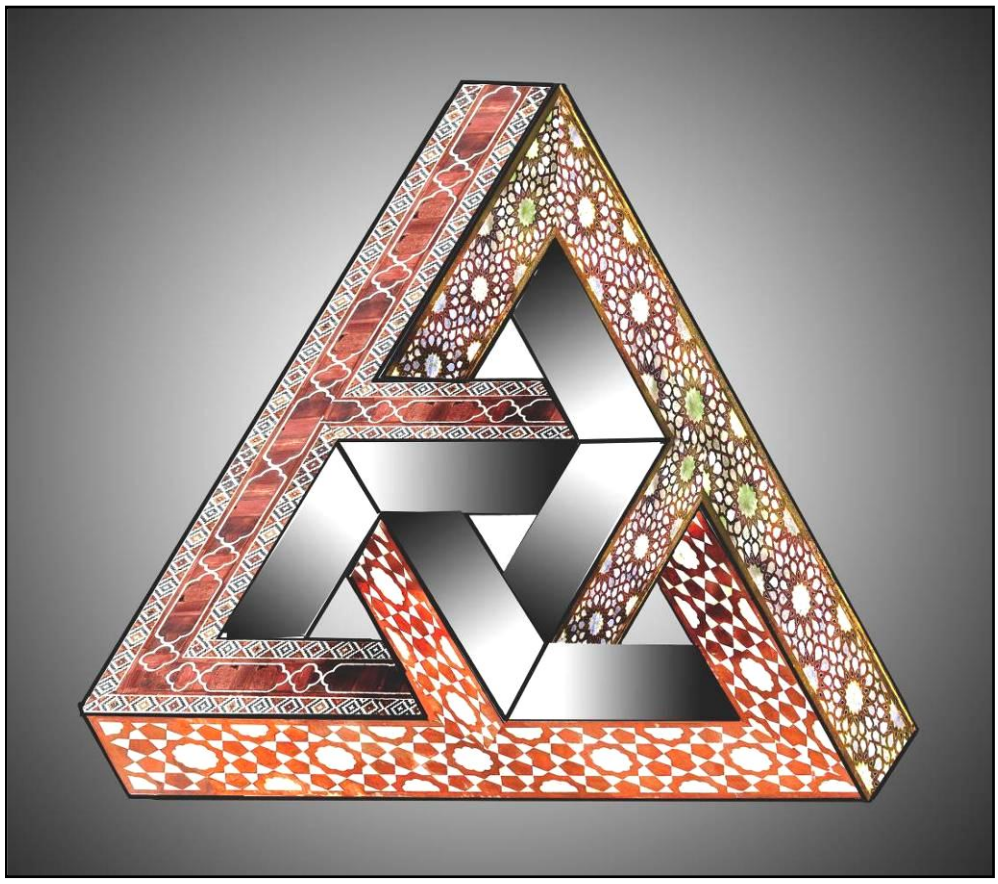


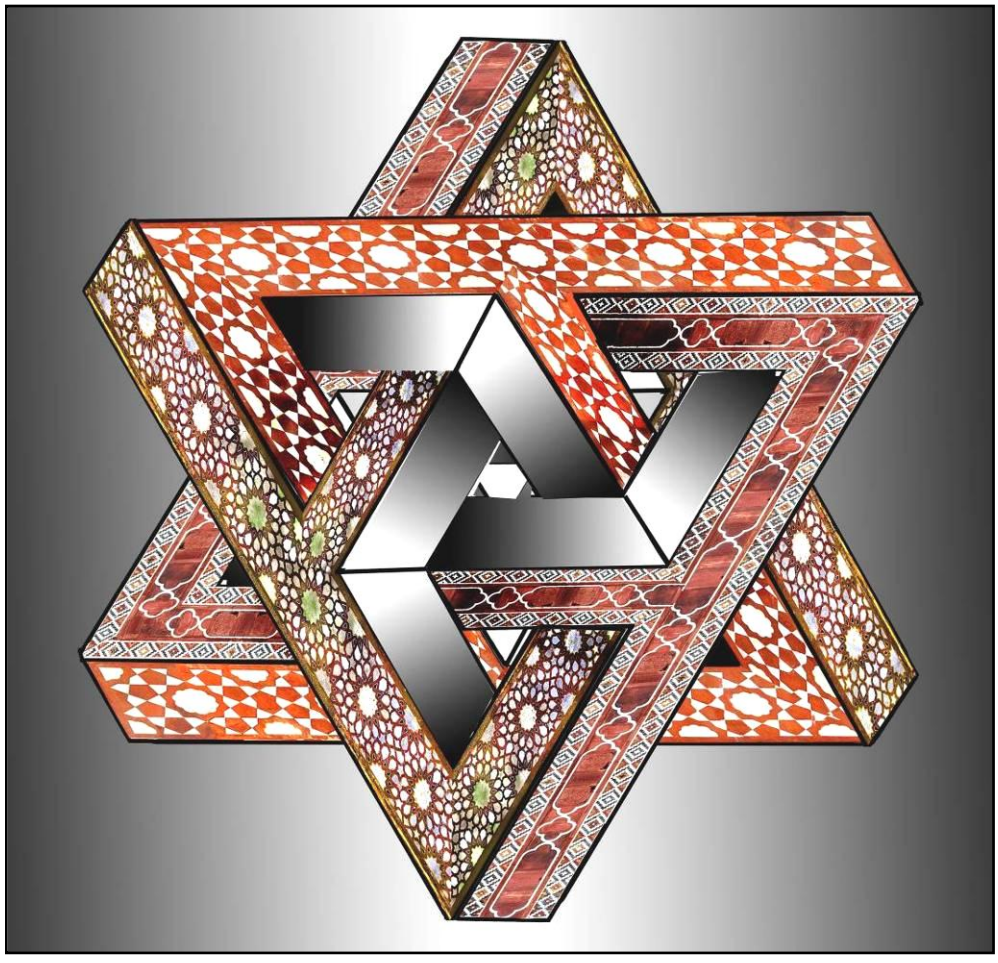


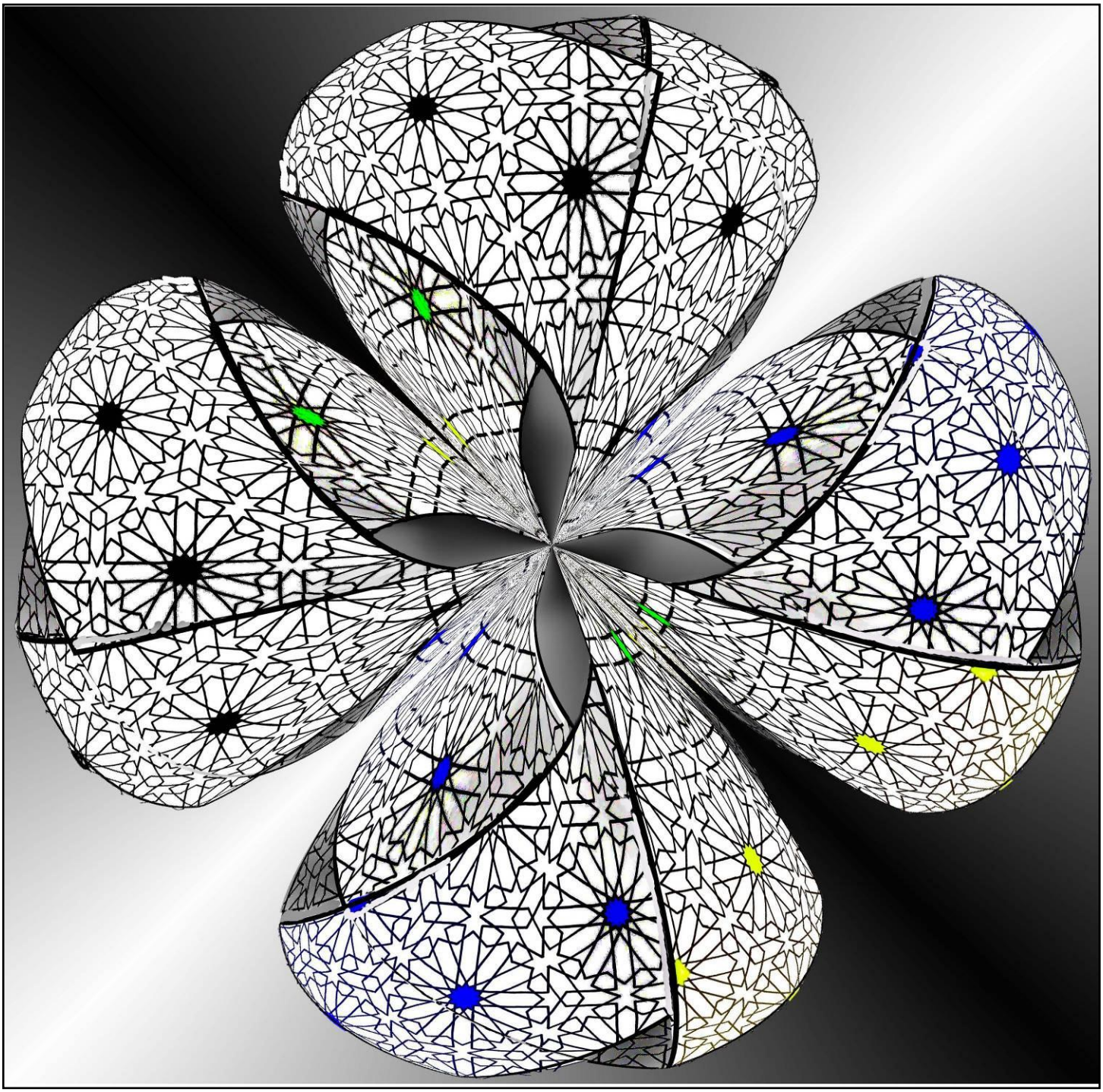


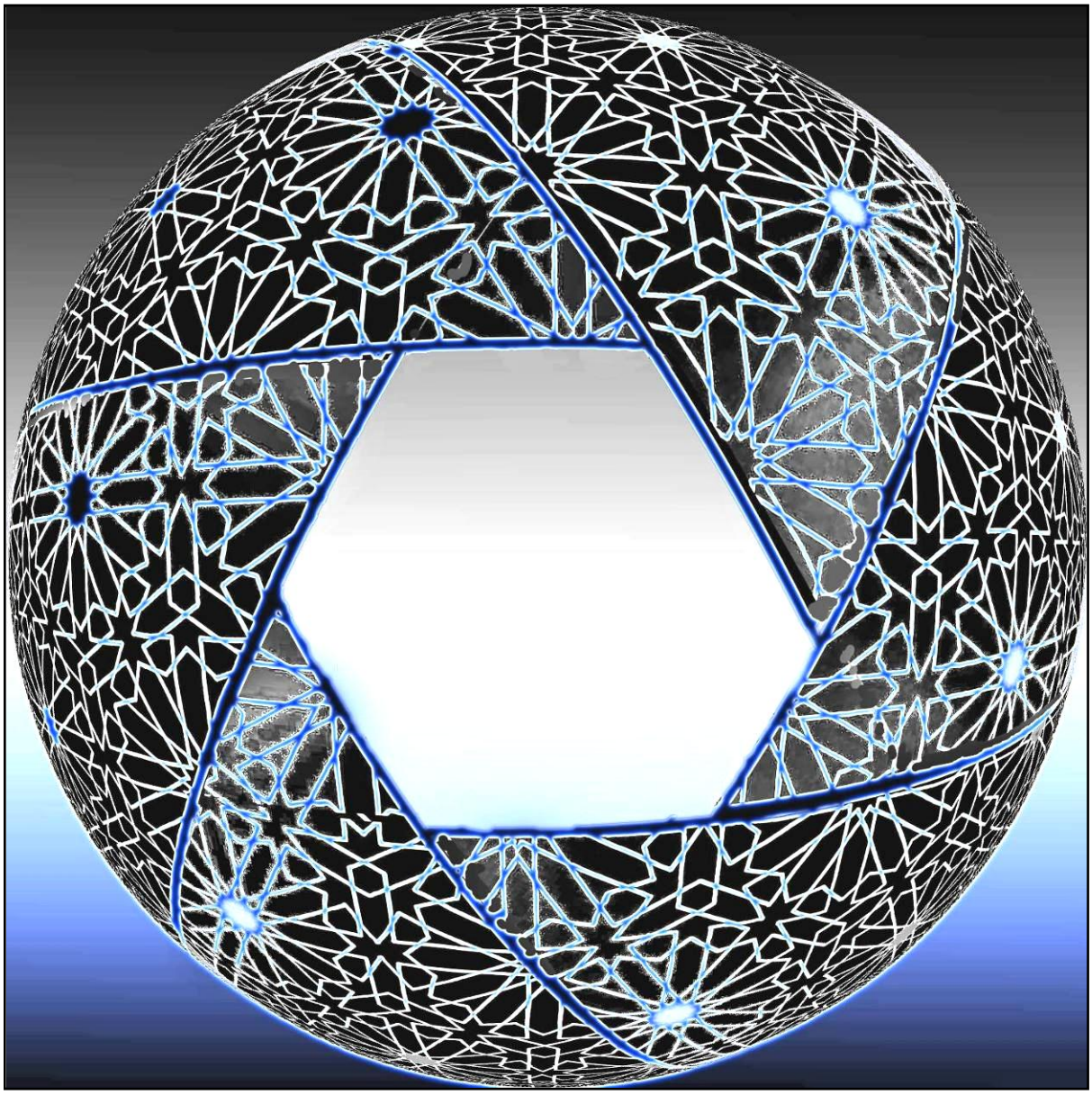


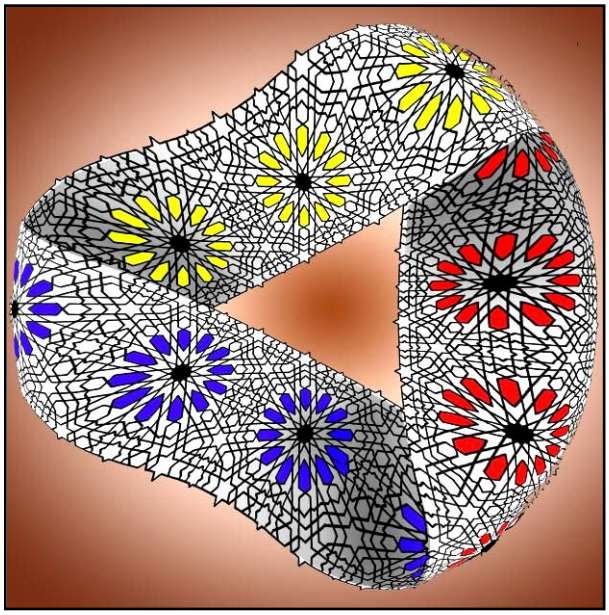
CONSTRUCTION

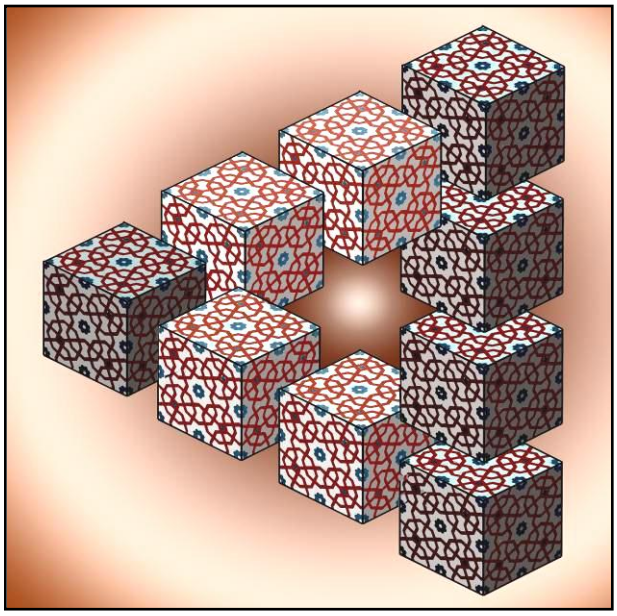












PAVAGE D'ARABESQUES

TOME 26 : la géométrie des arabesques

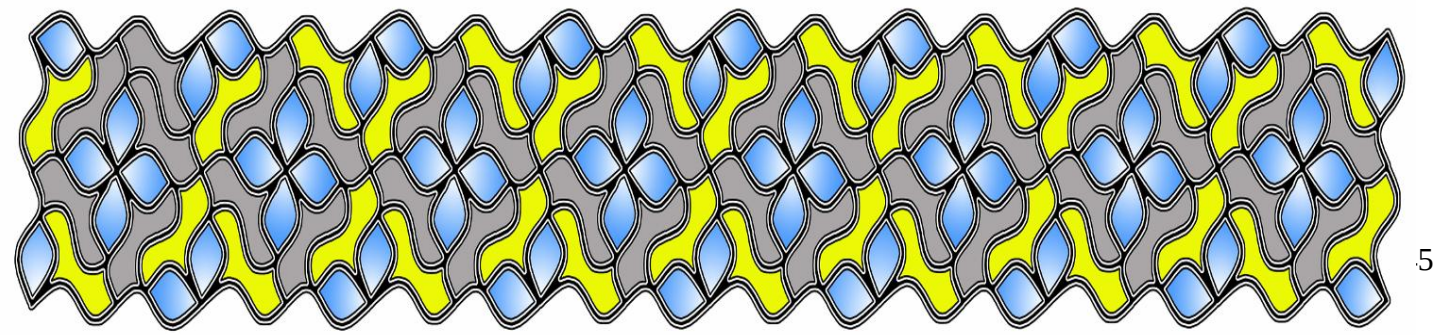
Par Louis ARNAUD

PAVAGES D'ARABESQUES

La géométrie des arabesques.

Un pavage consiste à recouvrir l'ensemble du plan par la juxtaposition d'un même motif sans laisser d'espace. L'arabesque est un exemple de pavage non figuratif ; cependant un pavage peut être figuratif. L'étude suivante explique les règles générales de construction pour un pavage quelconque.

Par Louis Arnaud



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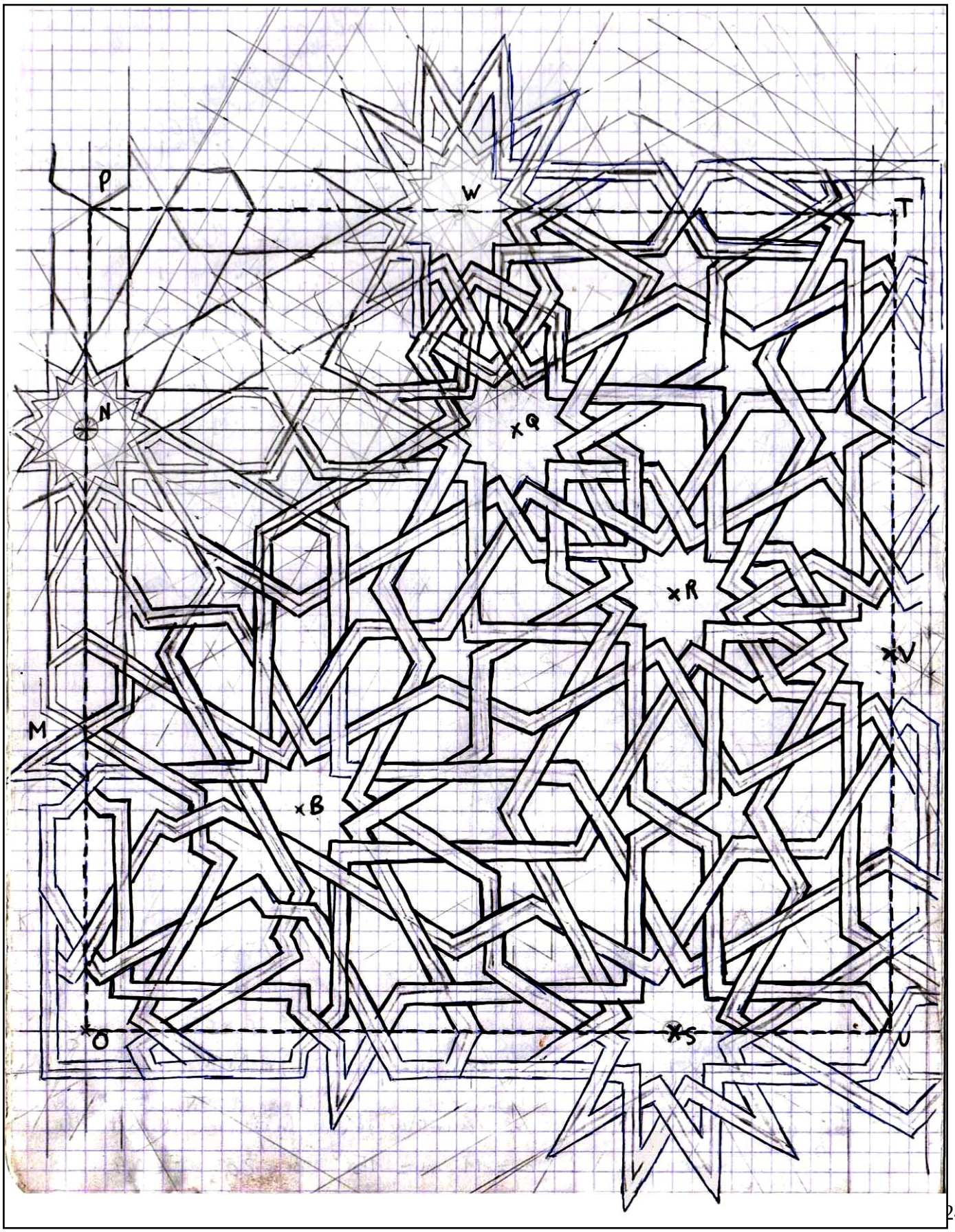
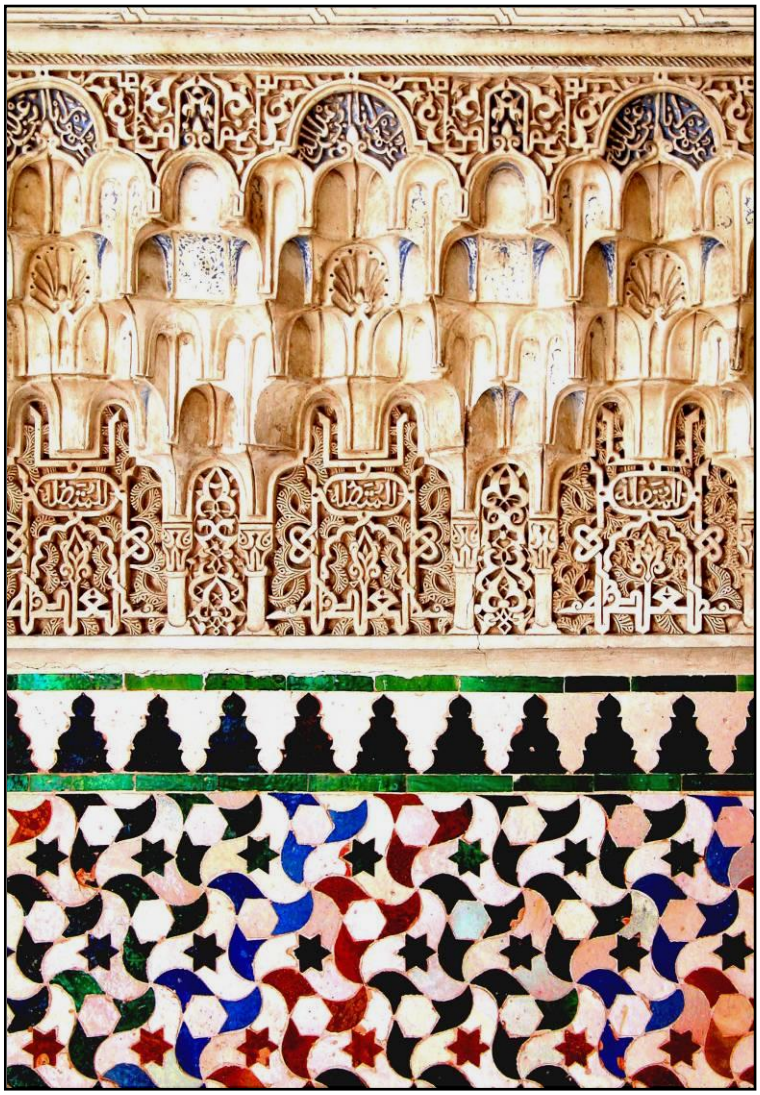
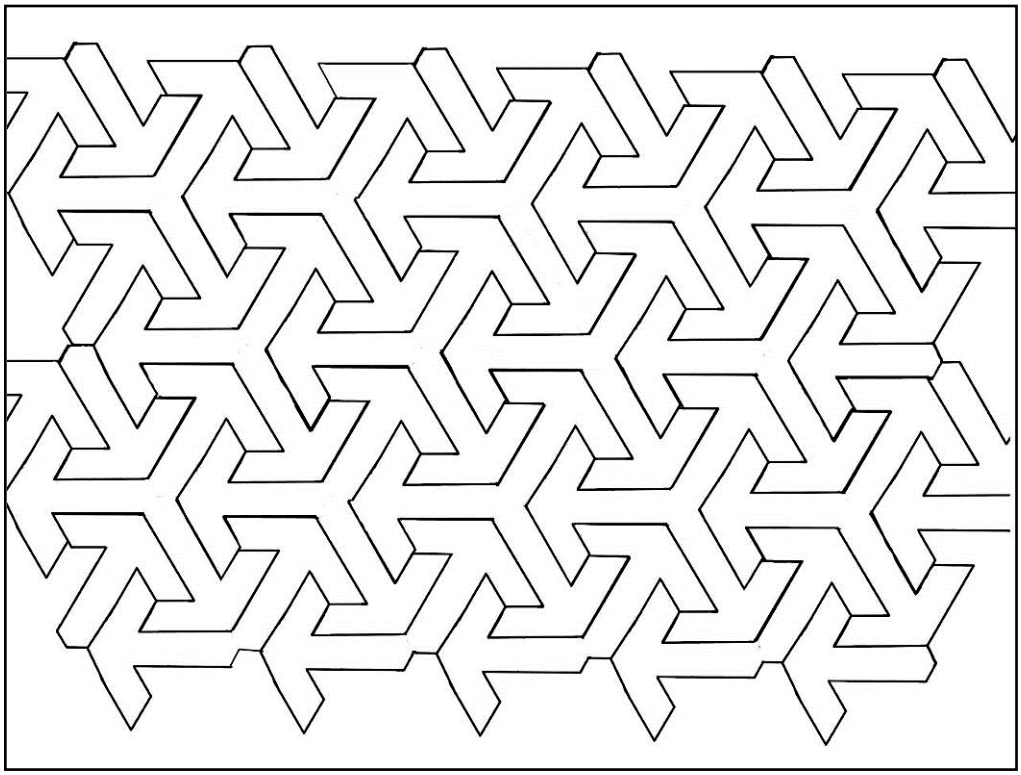
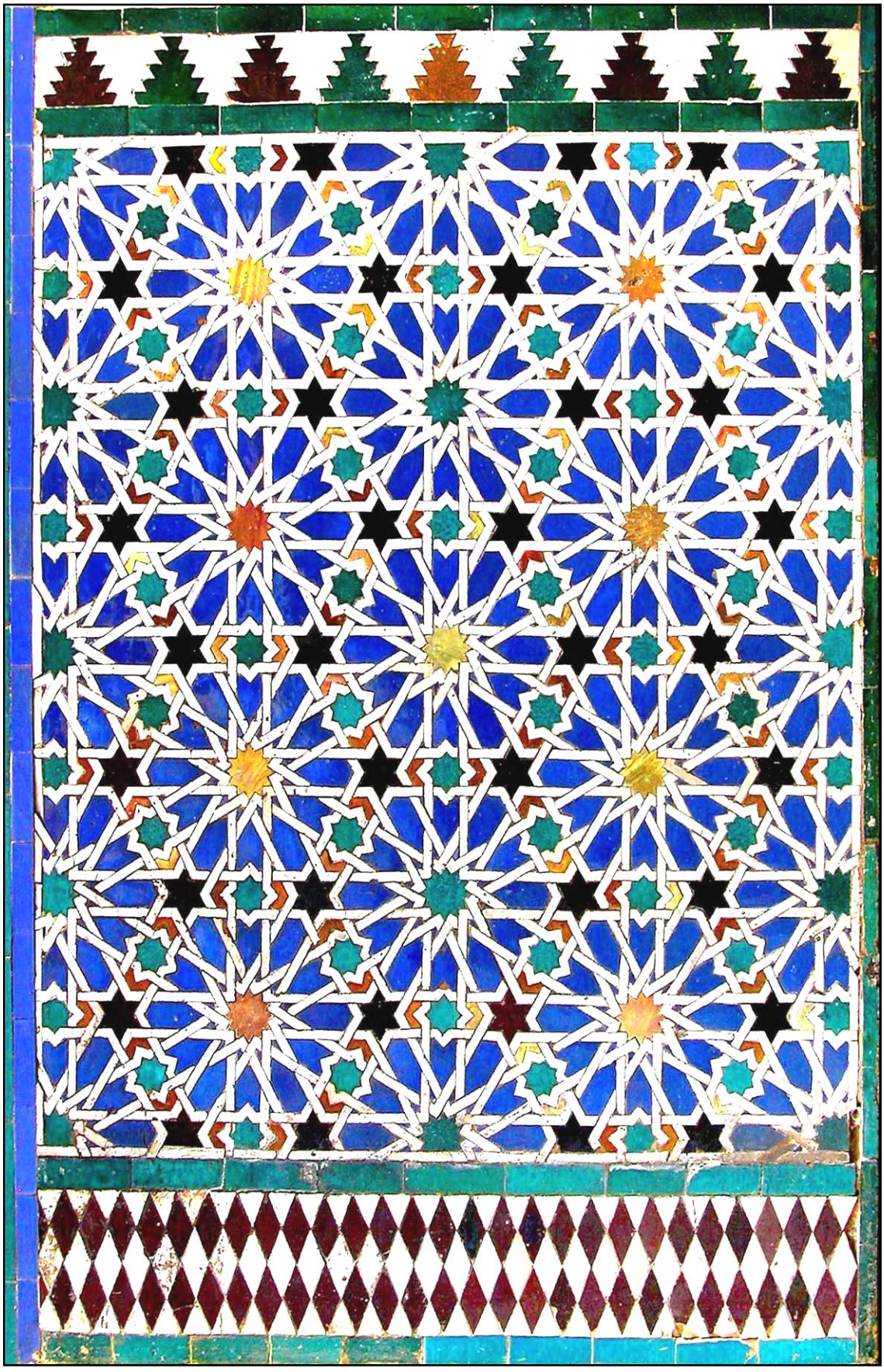
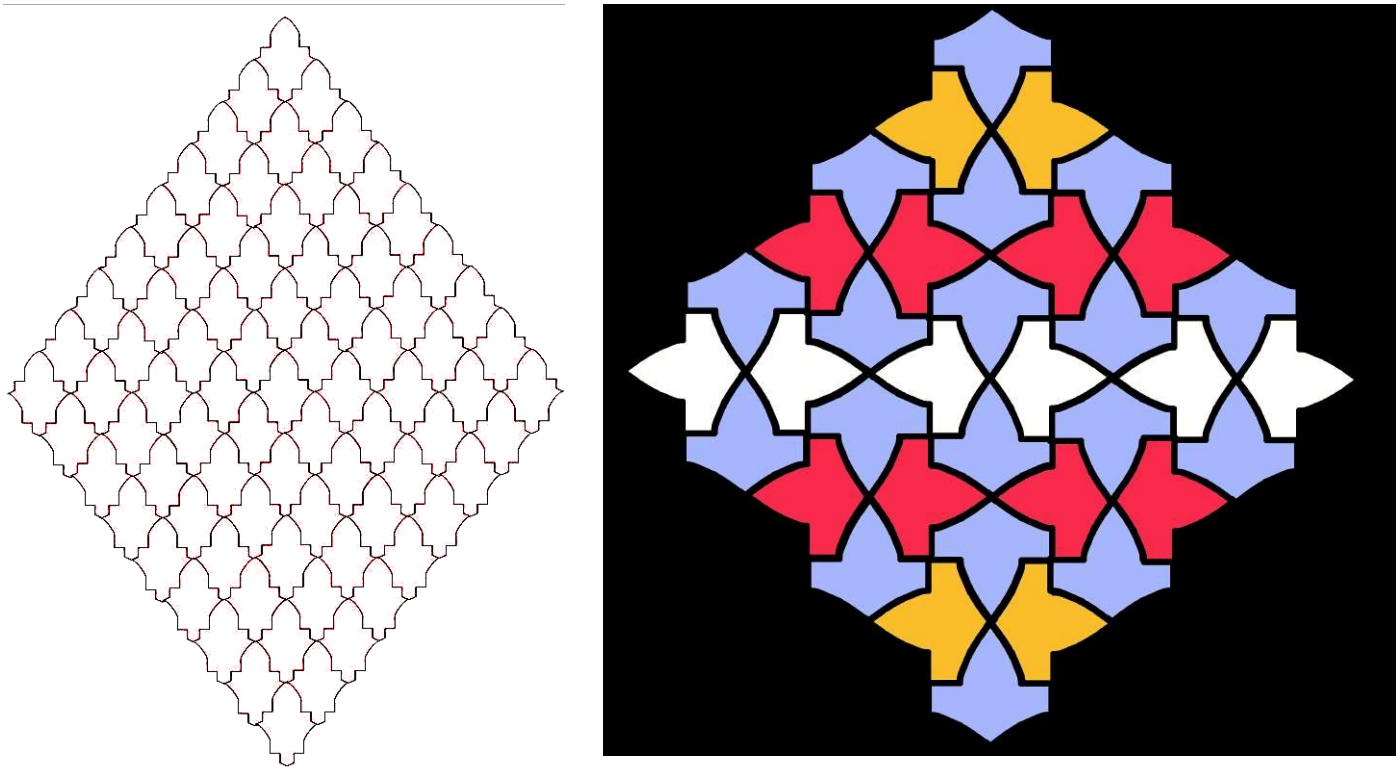




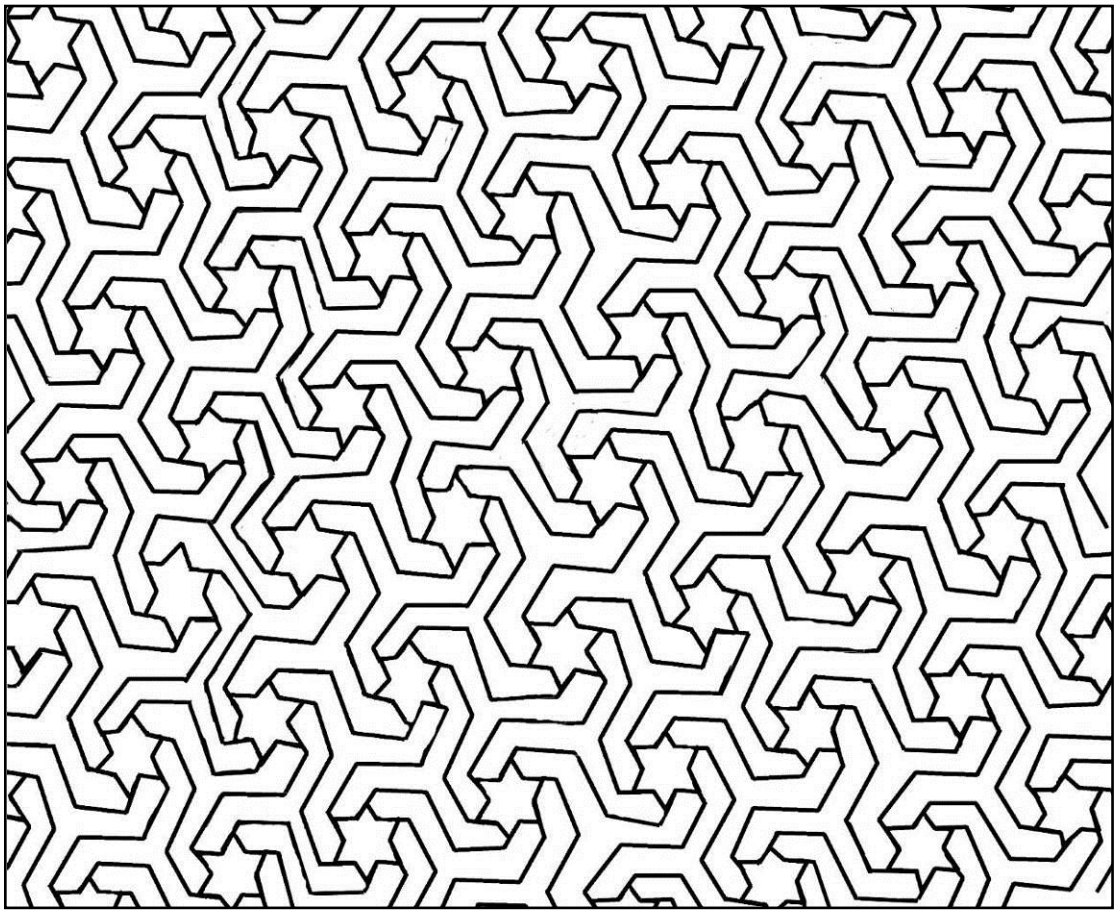




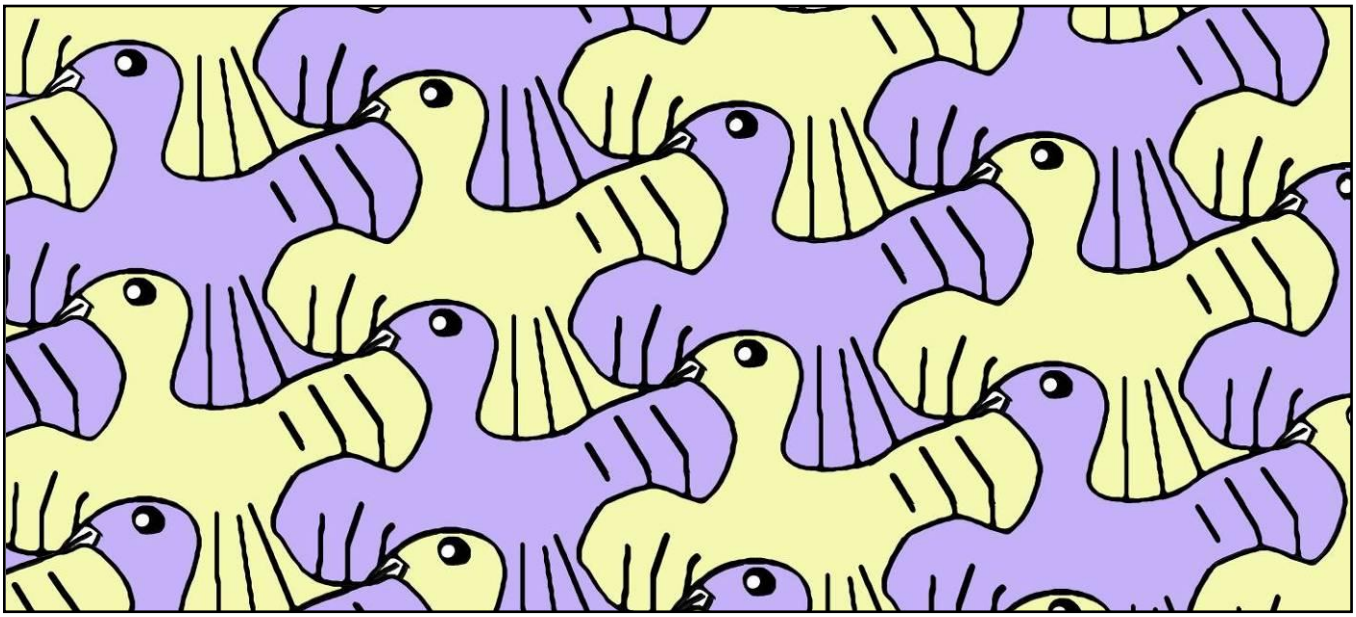
Composition d'étoiles à douze formant un pavage non figuratif. Alcazar de Séville.

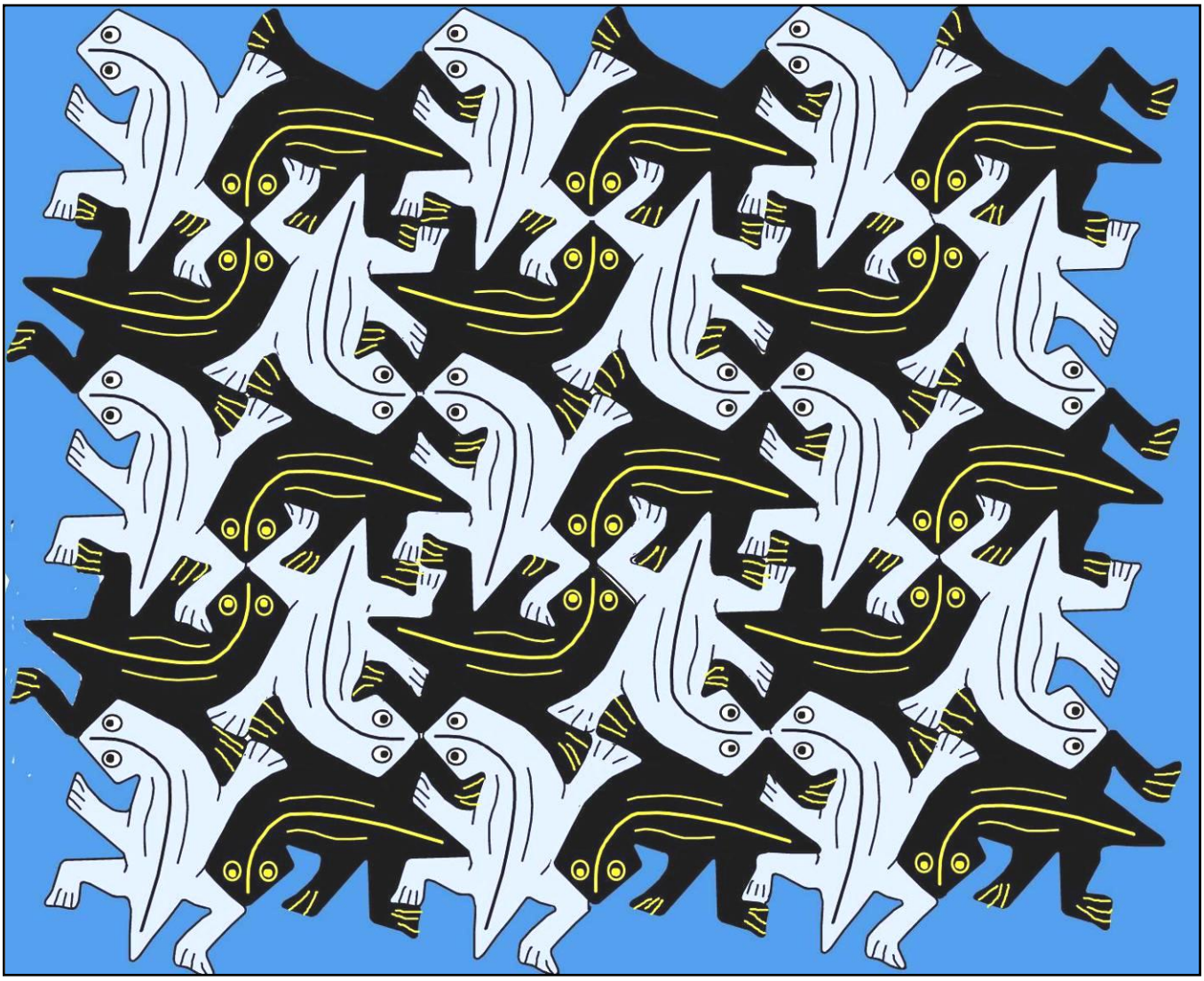


Pavages de style andalou.



Mosquée du vendredi à Ispahan : relevé d'un pavage seldjoukide du XII ème siècle.

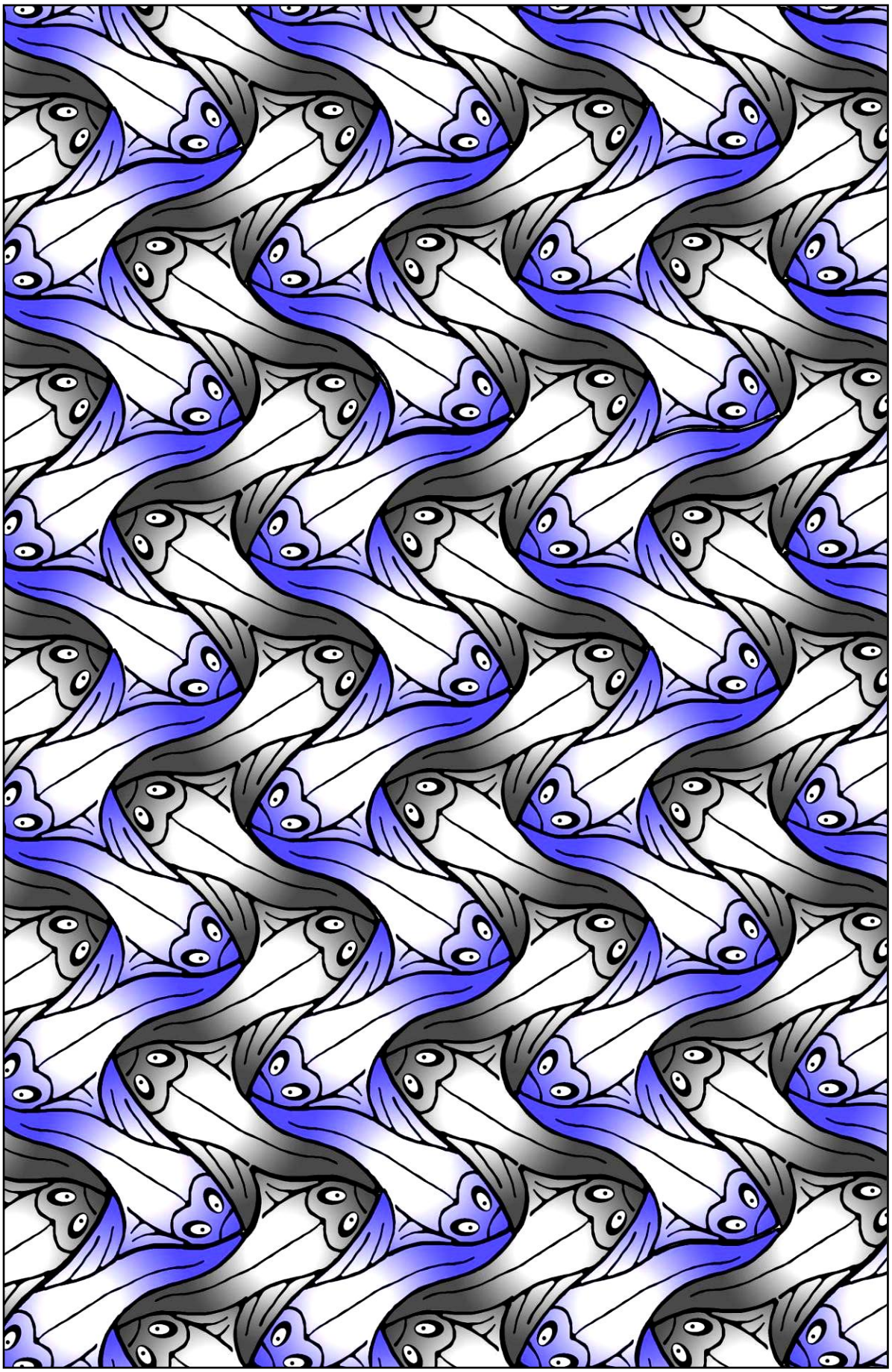




Oiseaux, lézards et poissons (page suivante) sont des pavages figuratifs étudiés dans le paragraphe qui suit ; pavages développés par le graveur hollandais Mauritz Cornelius Escher, maître du genre.

PHOTOGRAPHIES

DIAPORAMA



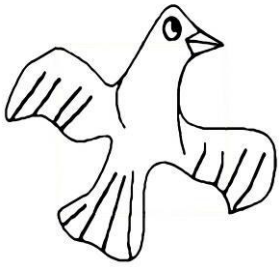
Pour tout profane, la notion de pavage est étroitement liée à celle de carrelage. Il n'en est rien :
Le pavage est une notion mathématique consistant à occuper totalement le plan par des **pavés** (ou tuiles). Cette notion est étroitement liée à la cristallographie ; en effet le pavage travaille dans une surface plane à deux dimensions alors que la cristallographie travaille dans un volume à trois dimensions ; cependant les mêmes règles sont applicables dans les deux cas.

De nombreux mathématiciens se sont penchés sur ces problèmes apparemment simples et s'y sont cassés les dents : de nombreux théorèmes attendent encore leur démonstration.

Nous laisserons donc loin de nous le côté mathématique pour nous intéresser qu'au côté manipulation ainsi qu'à sa valeur artistique.

Nous voulons du simple.

En premier lieu, l'étude va privilégier la recherche des figures simples et identiques capables de paver l'ensemble du plan sans superposition et sans laisser de vides, ces figures ayant seulement en commun une frontière. : ce sont les **pavés.**



Pavé figuratif permettant le recouvrement de tout le plan.

Pavage de type Escher ; remarquer que les oiseaux sont tête bêche.

Mauritz Cornelis Escher : un grand artiste et spécialiste du pavage.

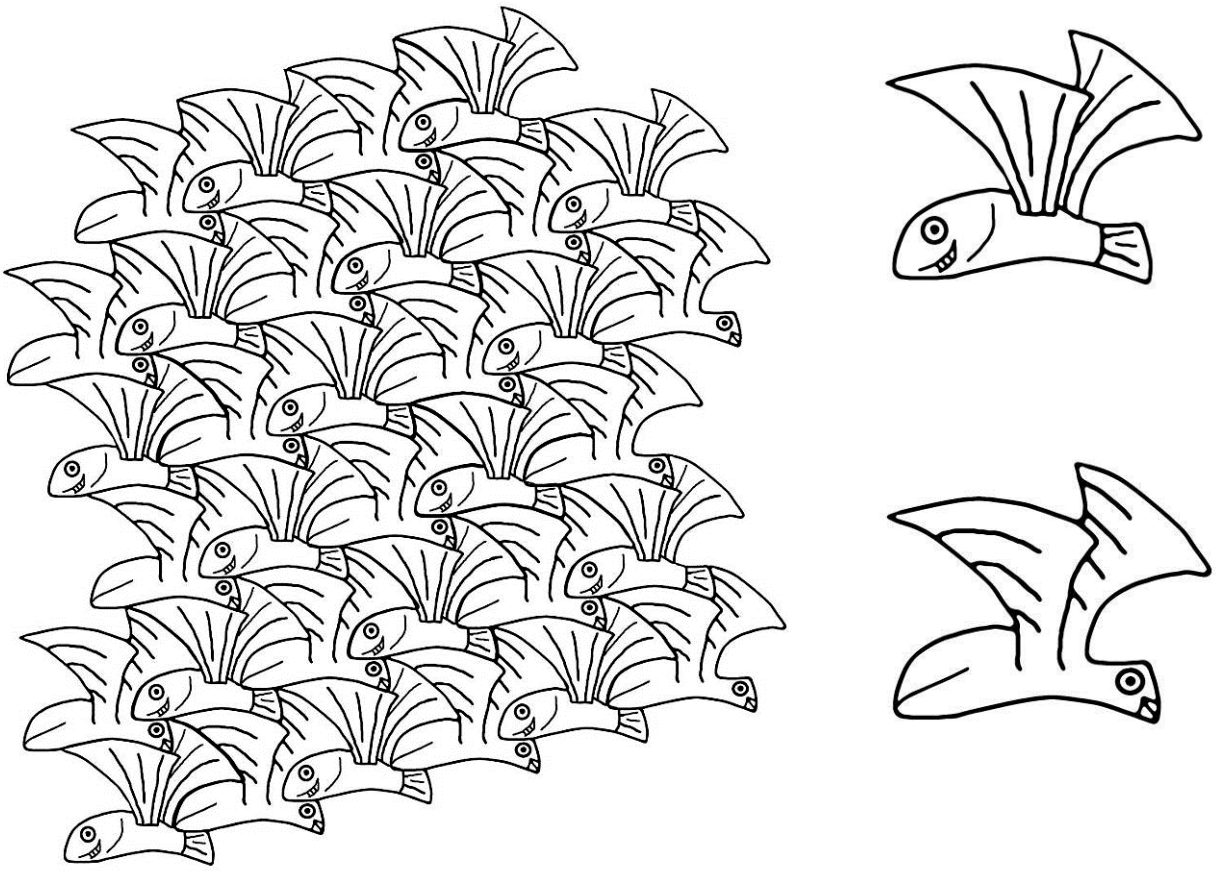
Mauritz Cornelis Escher est sans contexte celui qui a fait découvrir l'art du pavage. Graveur de talent, il été subjugué par la beauté et la complexité des arabesques nasrides de l'Alhambra de Grenade, il a su en extirper la substantifique moelle pur nous présenter ses propres créations extraordinaires.

Sa rencontre avec l'art islamique, lors de son voyage en Andalousie, a profondément influencé son oeuvre ; les pavages complexes de l'Alhambra de Grenade, temple de l'arabesque géométrique, utilisent les propriétés géométriques des transformations isométriques :

Les translations,
Les rotations,
Les symétries,
Les rotations glissées.

C'est des murs, sols et plafonds de ce palais qu'a jailli l'étincelle qui a permis à Escher de développer toute son inspiration pour nous faire parvenir ses pavages figuratifs, ses perspectives inhabituelles et ses jeux de lumière.

Nous allons essayer d'expliquer de la manière la plus simple possible comment construire un pavé figuratif ou non figuratif. Nous ne pouvons rien inventer dans ce domaine car tout a déjà été fait, par contre nous pouvons toujours interpréter à notre guise.

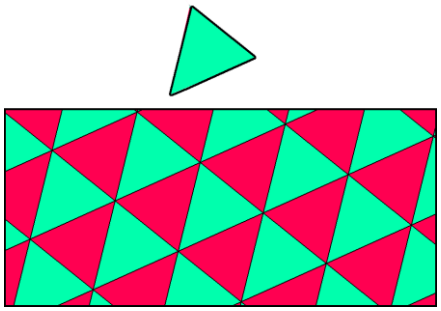


Le même pavé a servi pou construire l'oiseau et le poisson volant

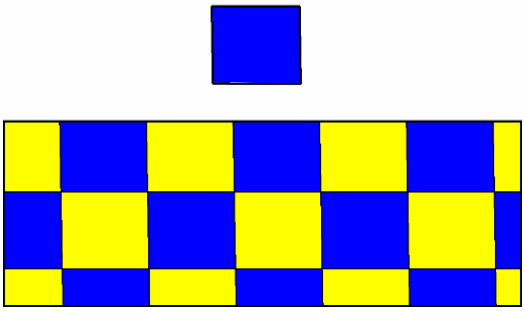
I. Pavage du plan :

a) Par des polygones **réguliers** :

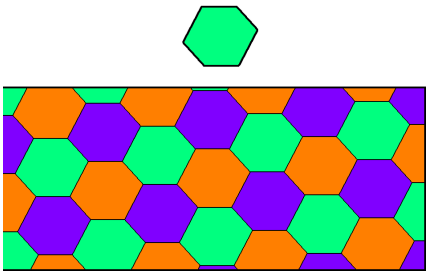
Seulement trois familles de pentagones réguliers peuvent paver le plan :



Les triangles équilatéraux.



Les carrés.



Les hexagones convexes.

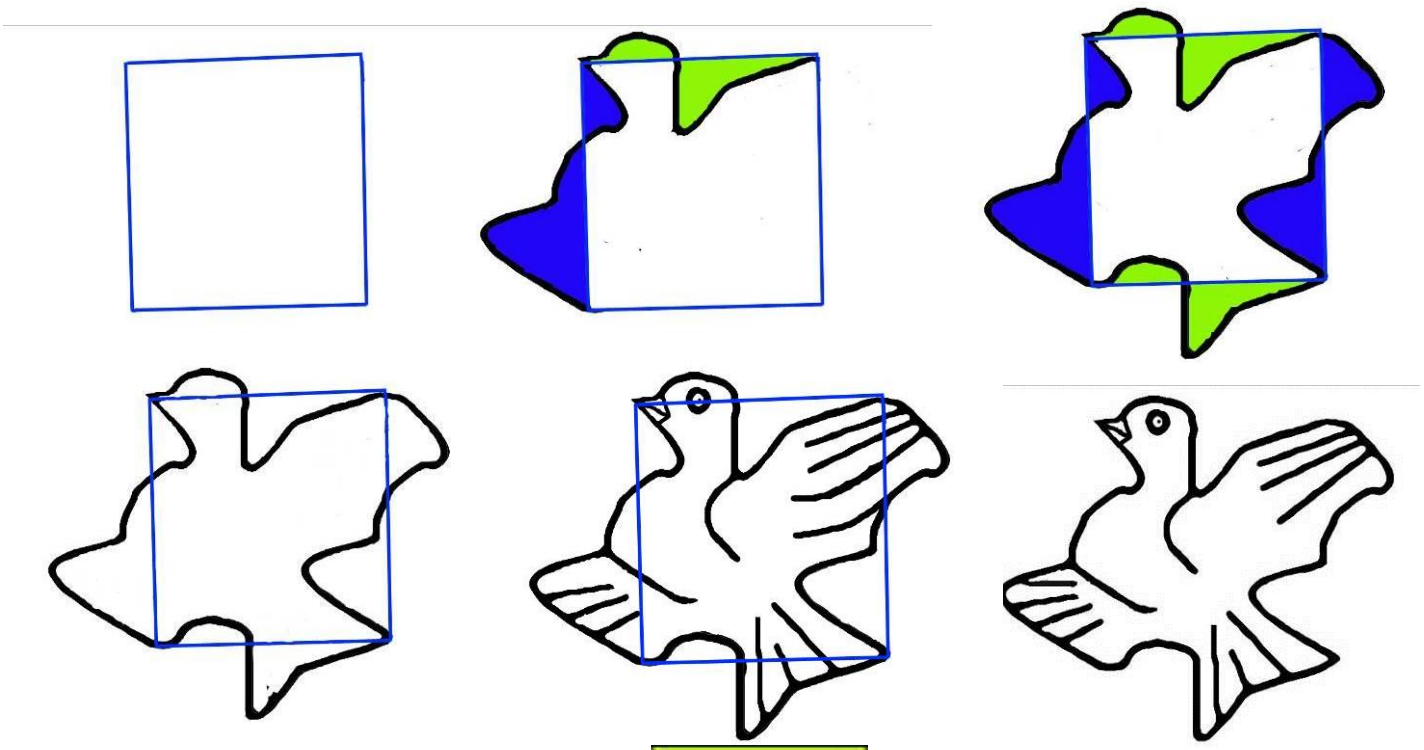
b) Déformations compensées :

Les côtés de ces polygones peuvent subir diverses déformations à condition de respecter les règles suivantes :

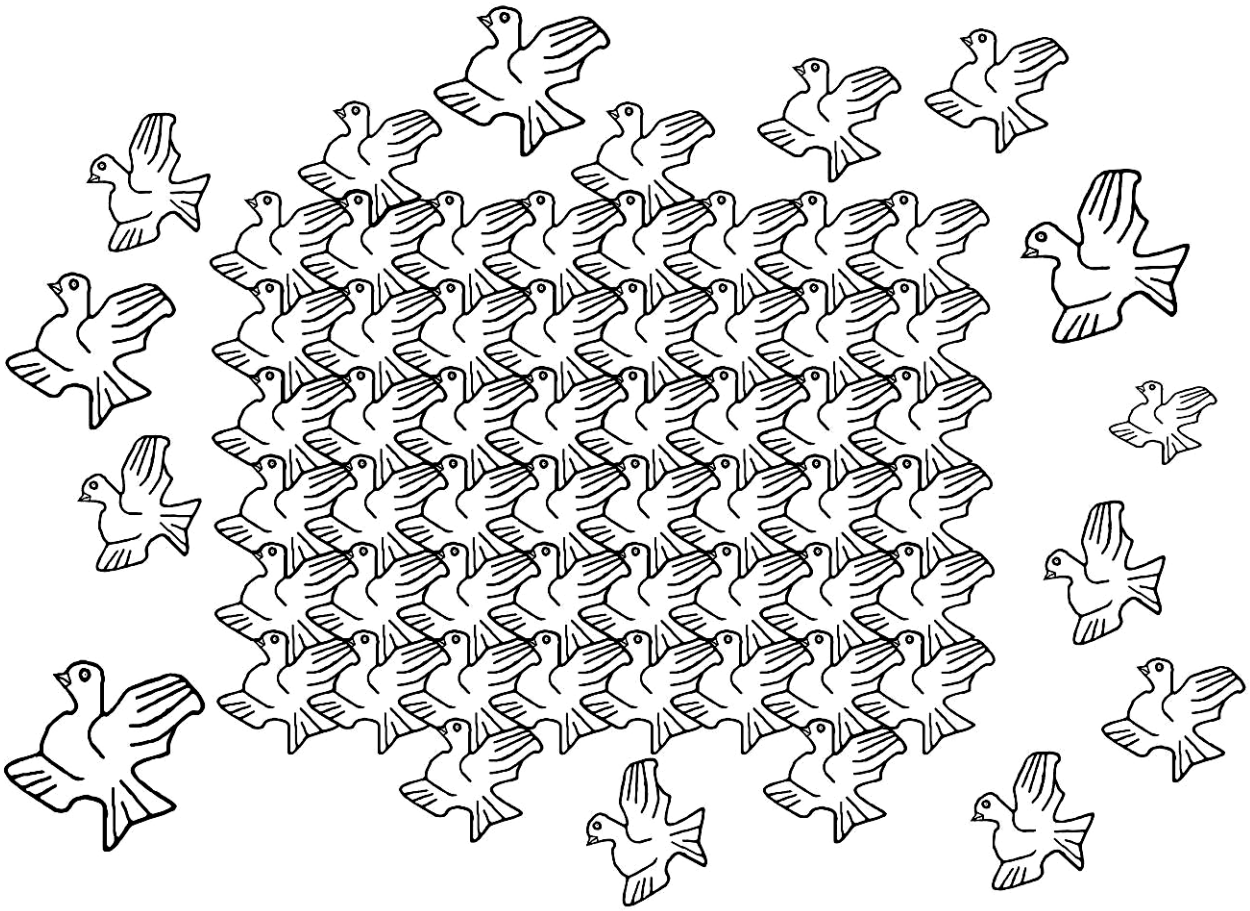
1-Ne pas modifier la surface du pavé.

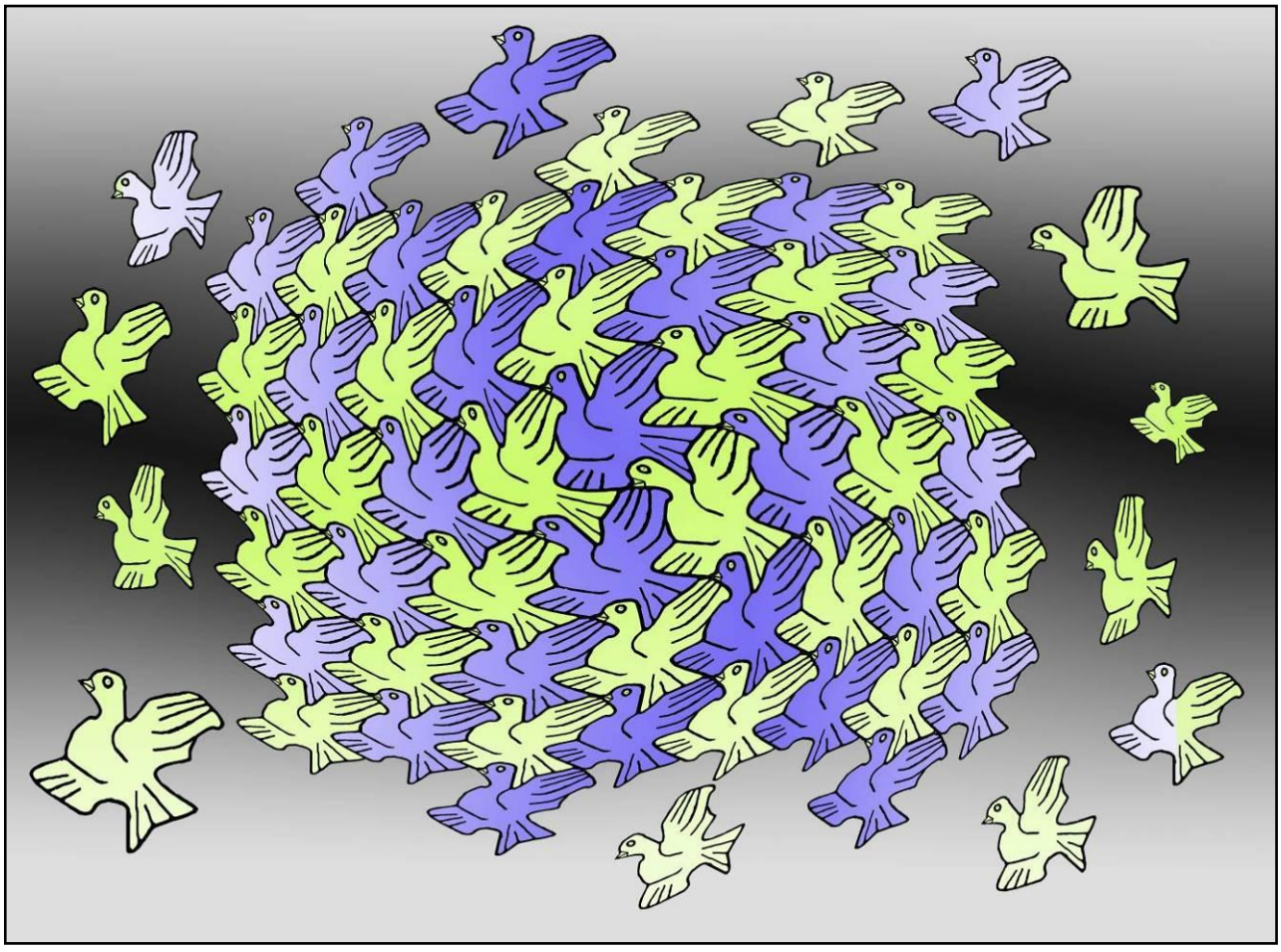
2-Compenser sur un autre côté par une déformation équivalente afin de pouvoir conserver les surfaces et d'ajuster les frontières entre deux pavés sans qu'ils se superposent.

Premier exemple : LE CARRE.

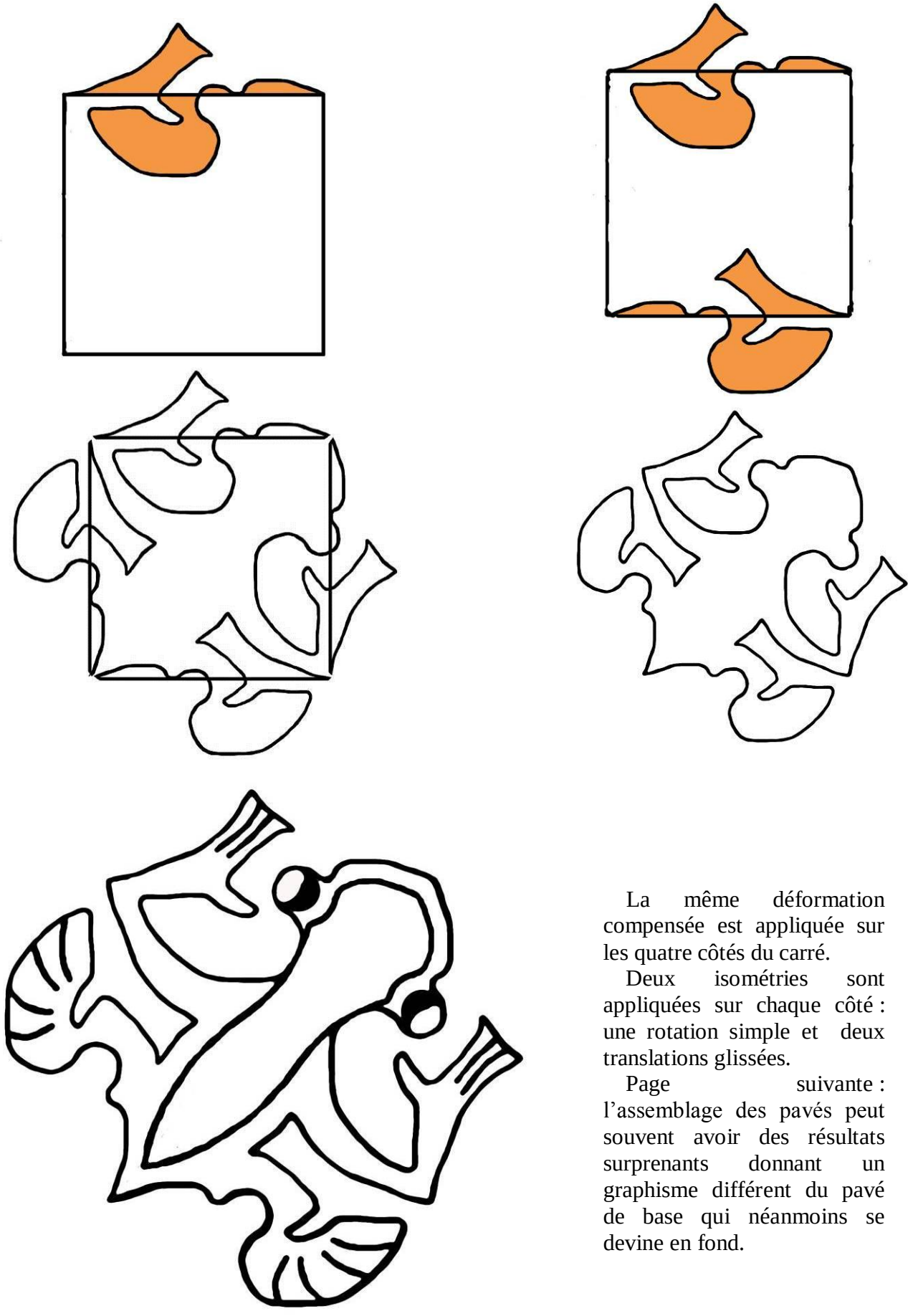


RETOUR





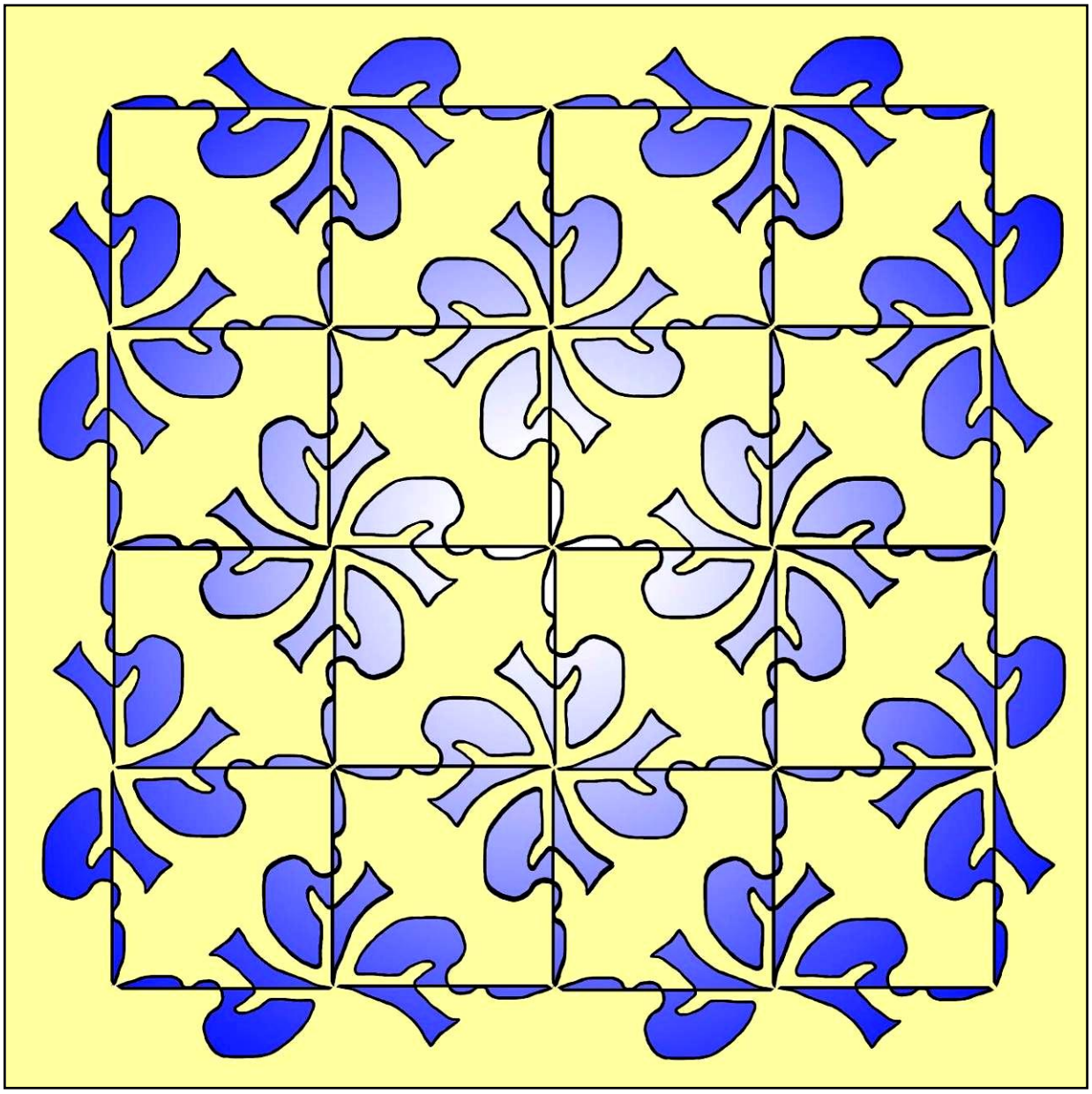
Deuxième exemple : LE CARRE.



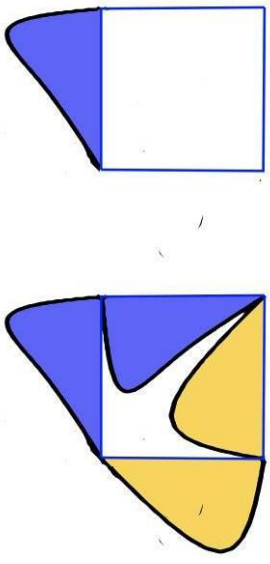
La même déformation compensée est appliquée sur les quatre côtés du carré.

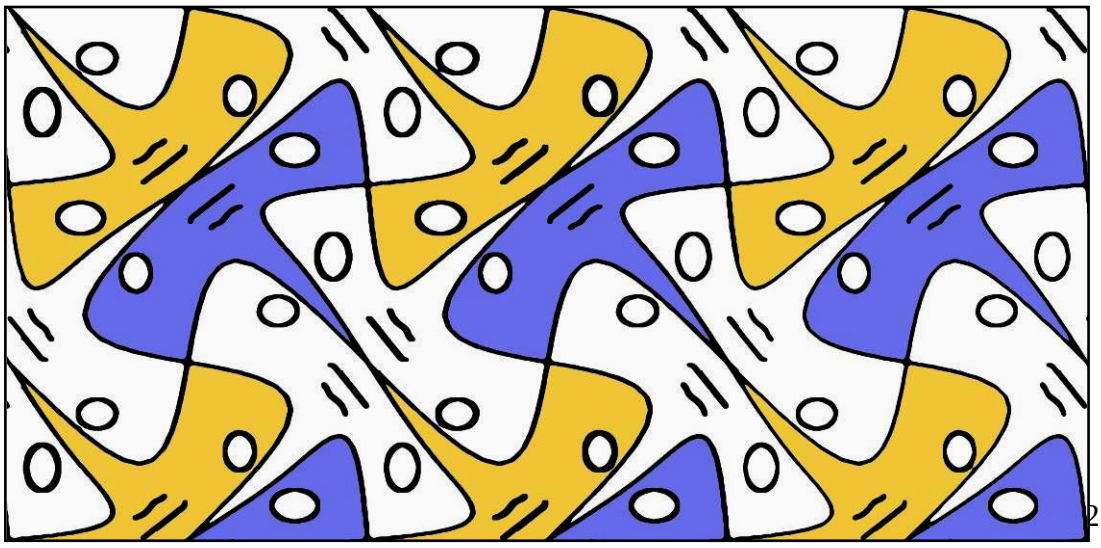
Deux isométries sont appliquées sur chaque côté : une rotation simple et deux translations glissées.

Page suivante : l'assemblage des pavés peut souvent avoir des résultats surprenants donnant un graphisme différent du pavé de base qui néanmoins se devine en fond.

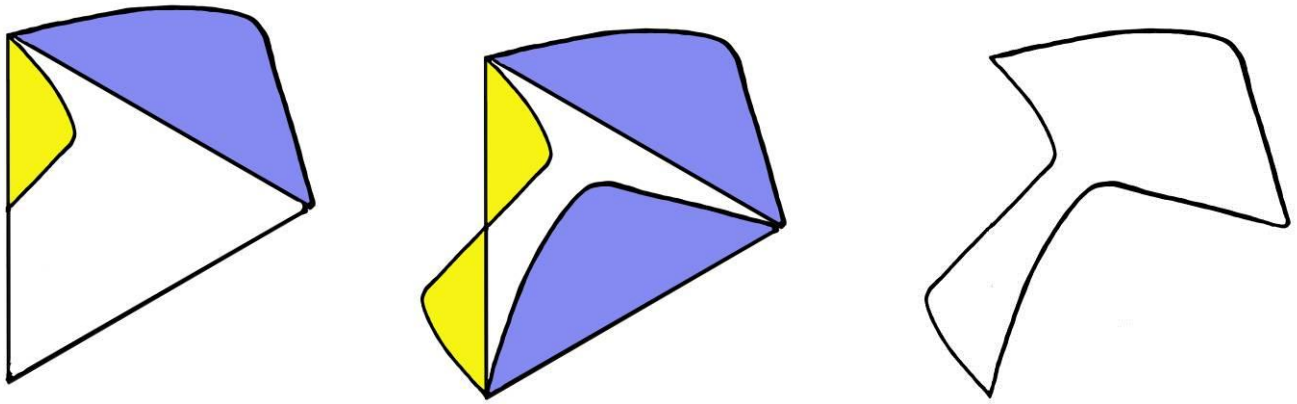


Troisième exemple : LE CARRE ; deux rotations.

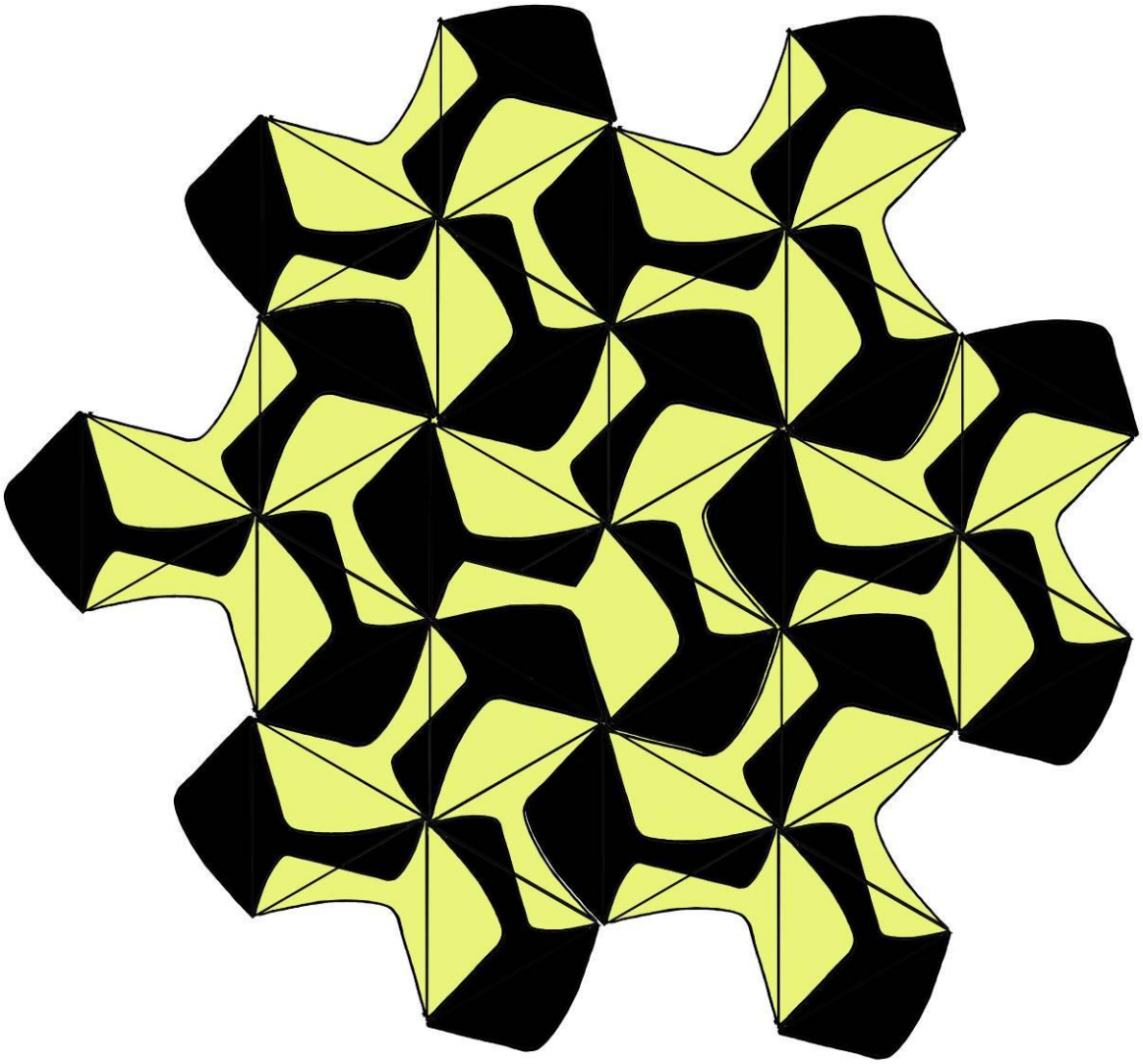


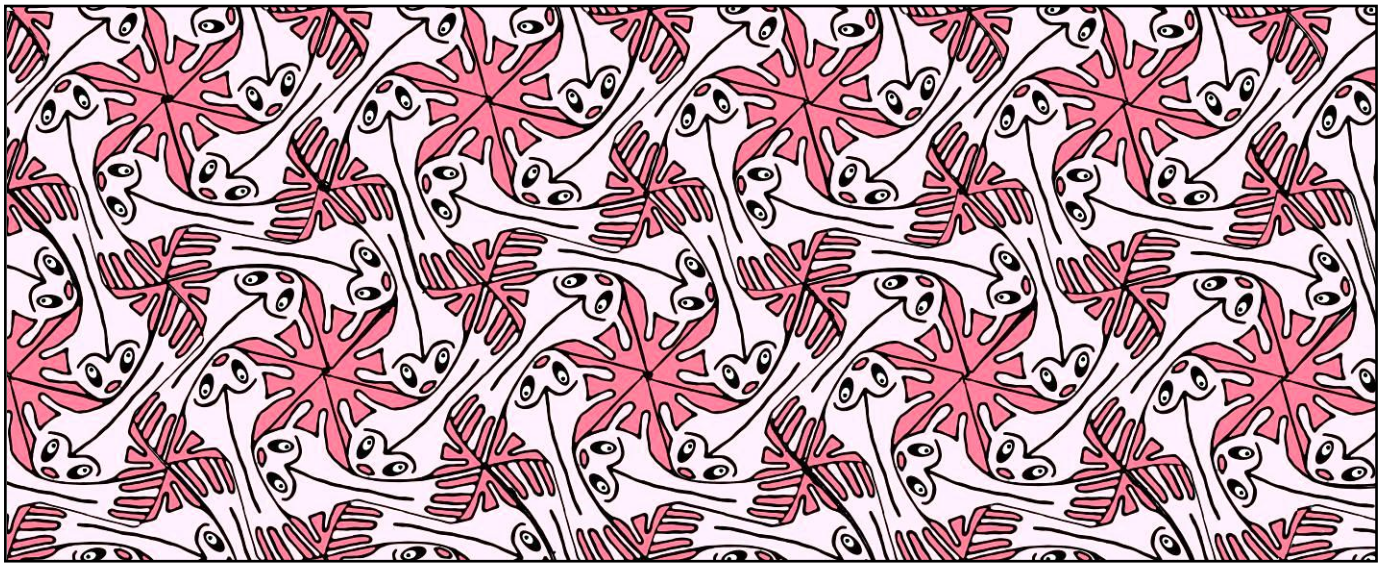


Quatrième exemple : le TRIANGLE EQUILATERAL.

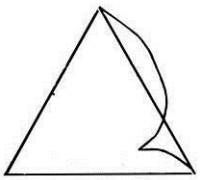


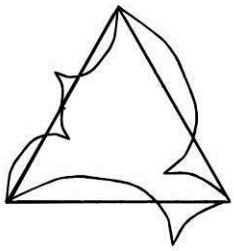
Pour ce pavage, deux isométries ;
En bleu, rotation de 60° avec comme centre de rotation un sommet.
En jaune une symétrie centrale.

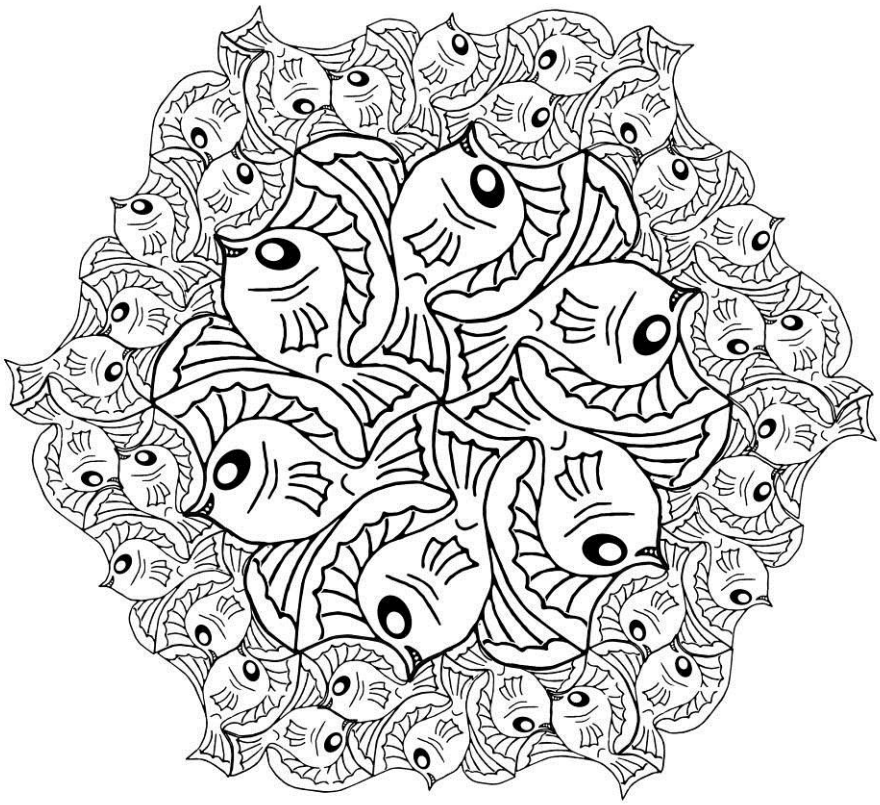




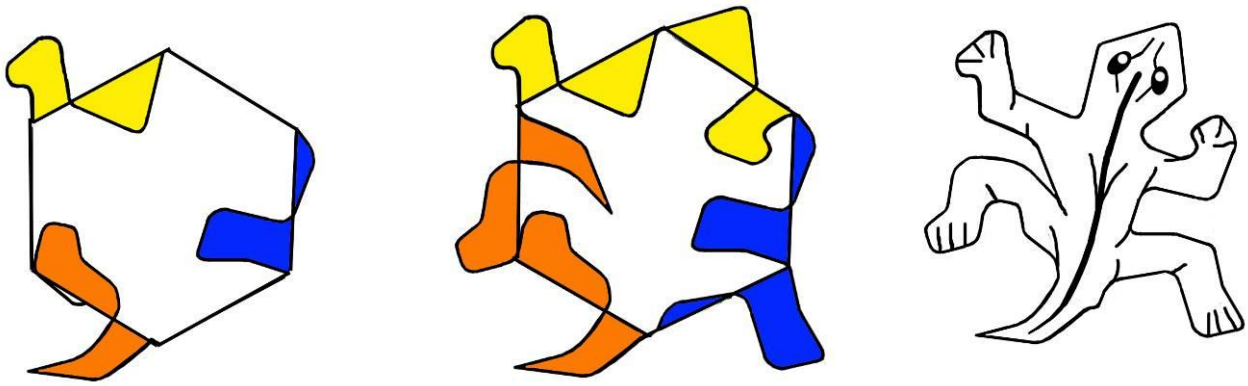
Cinquième exemple : le TRIANGLE EQUILATERAL.



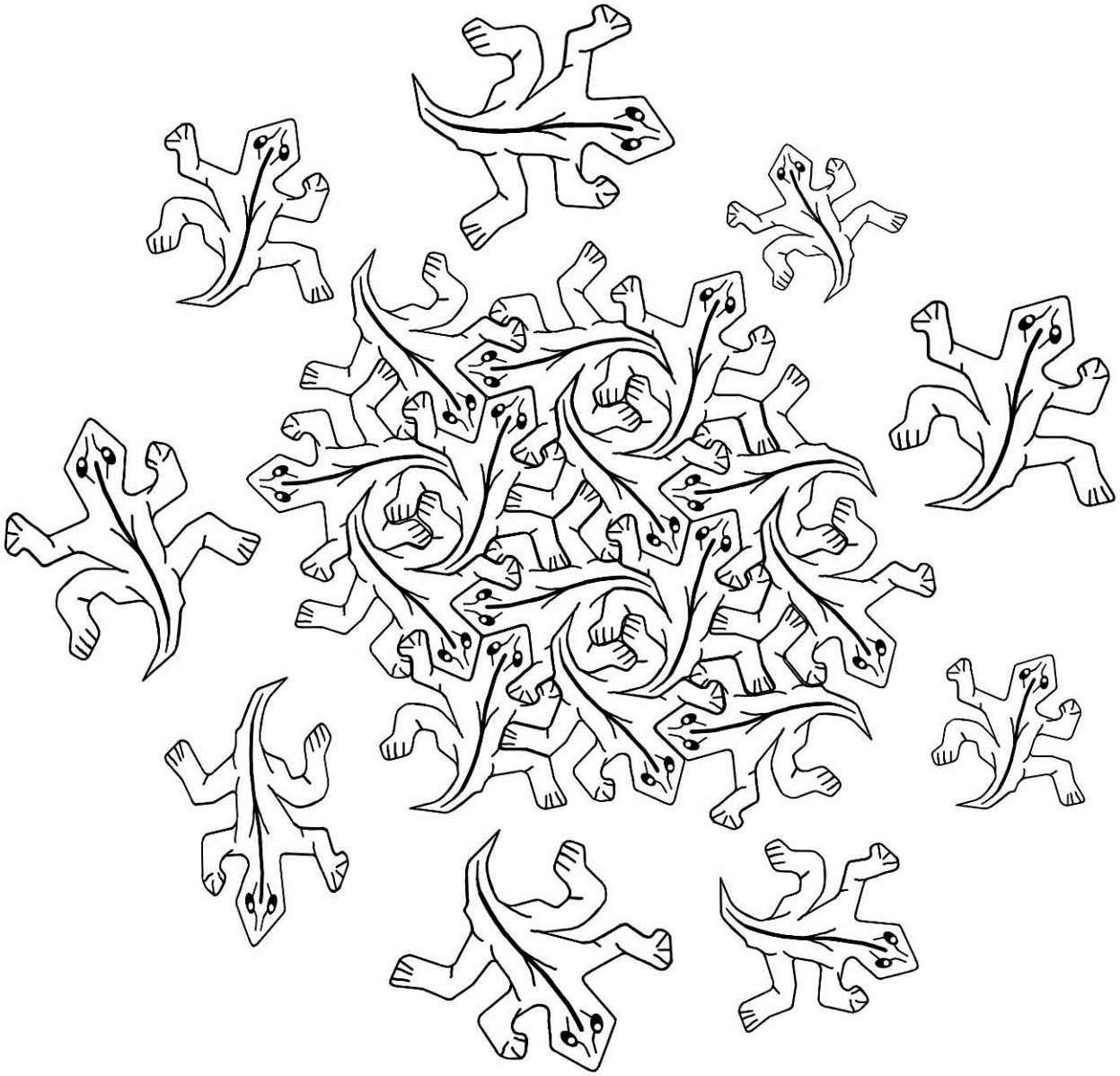




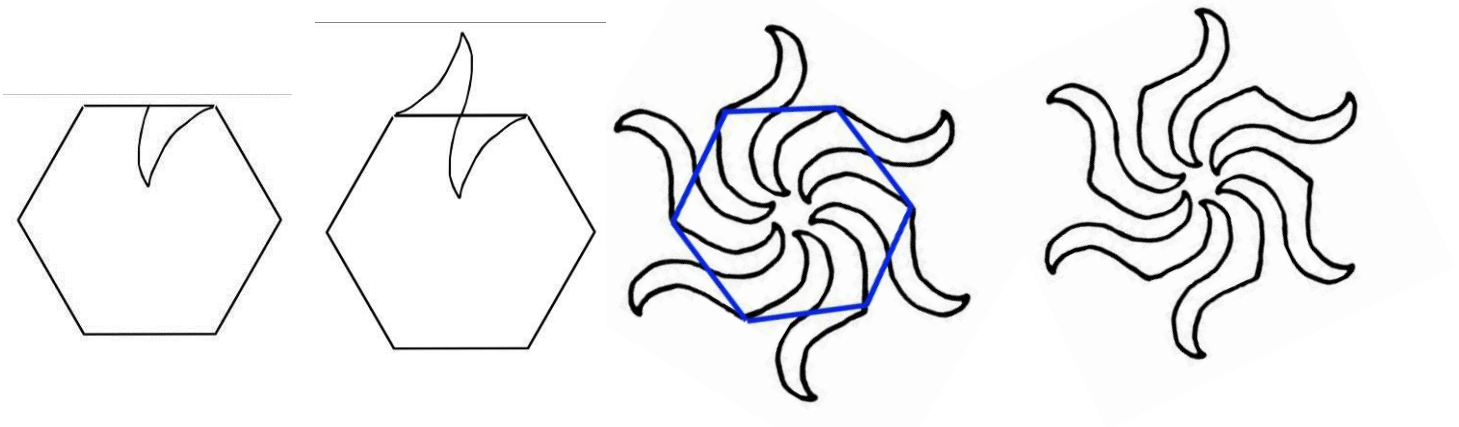
Sixième exemple : l'HEXAGONE.



Une rotation de 120° pour chaque côté permet de dégager la silhouette du lézard.

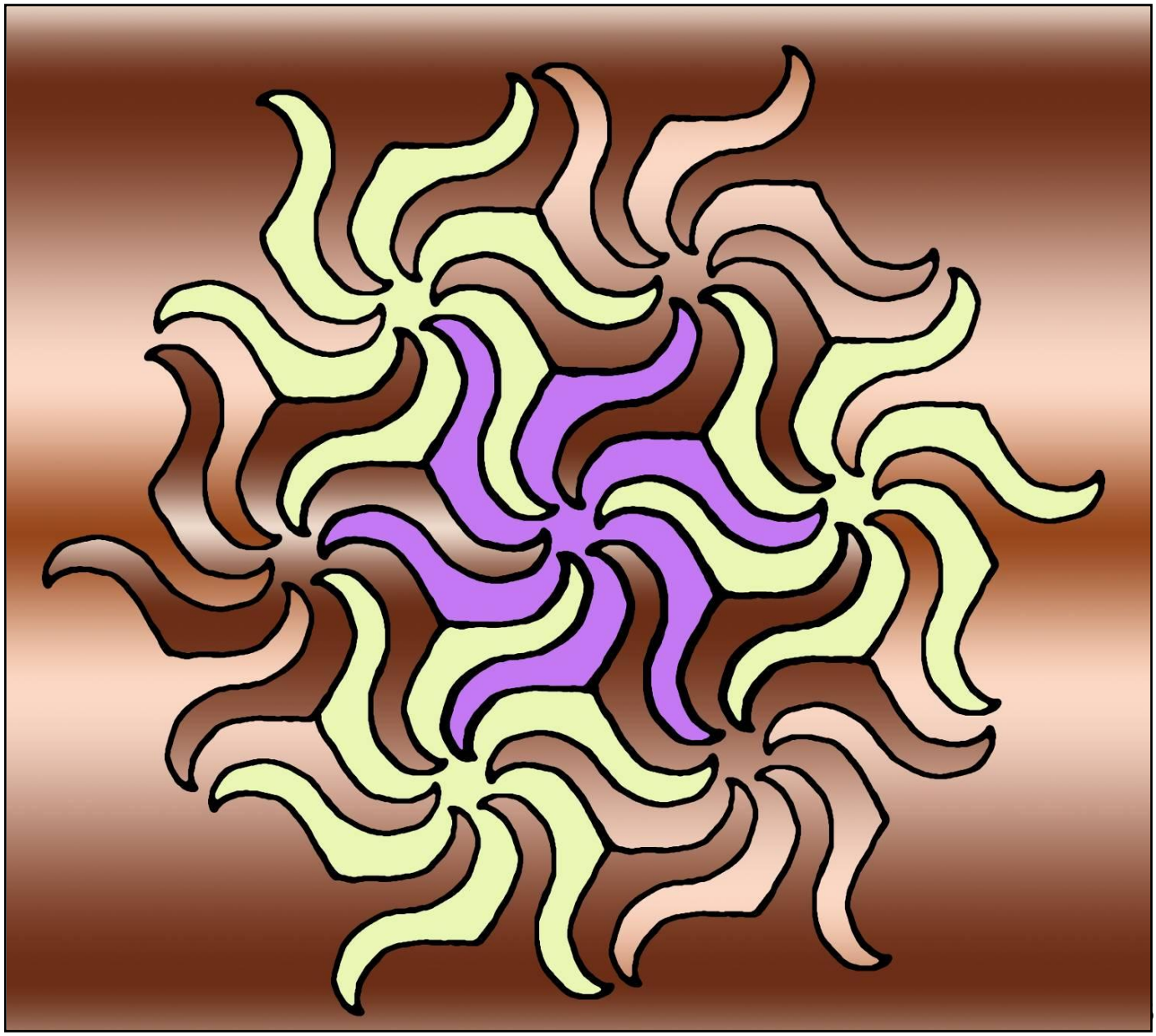


Septième exemple : l'HEXAGONE .



CONSTRUCTION

Chaque côté est défini par une symétrie centrale suivie d'une rotation glissée de chacun des côtés.

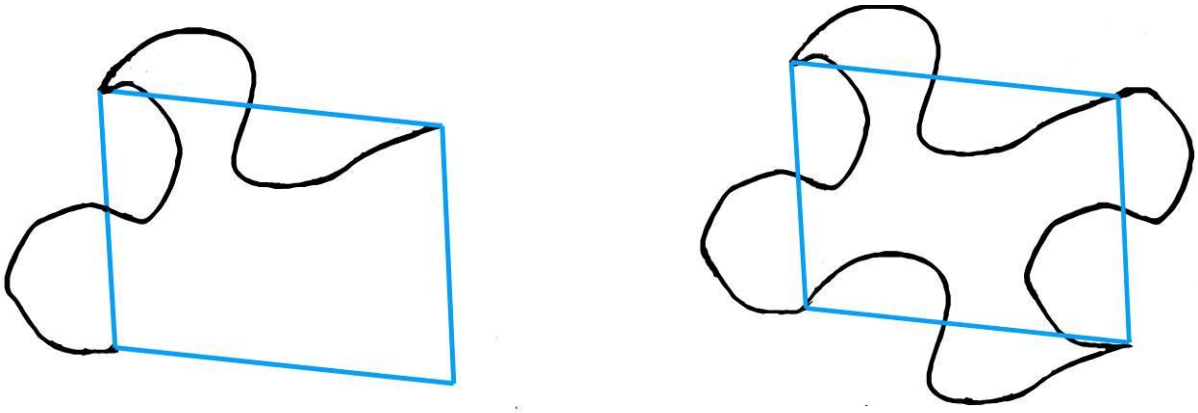


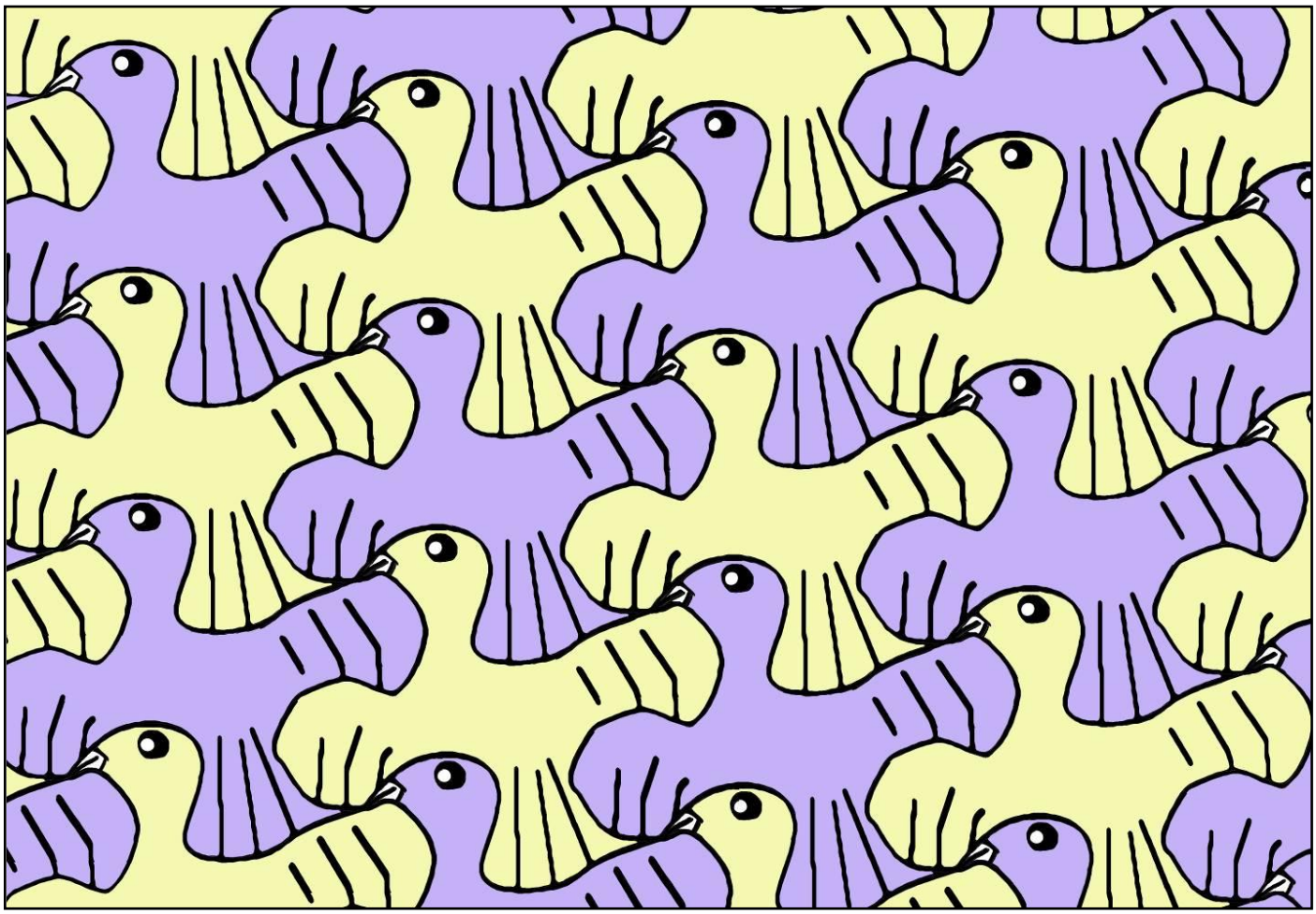
c) Les isométries :

Le rôle des isométries est de déplacer les déformations compensées pour quelles soient compatibles au pavage du plan en ajustant les frontières sans laisser d'espaces entre les pavés.

1- La translation :

Conditions : au moins deux côtés du polygone doivent être égaux et parallèles, c'est le cas pour les carrés, triangle équilatéraux et les hexagones.

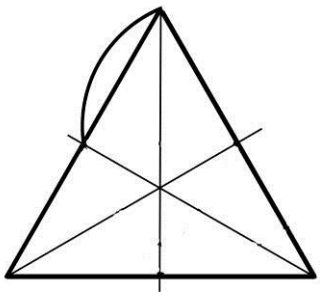


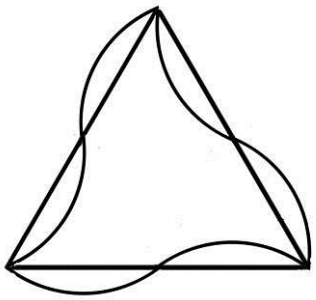


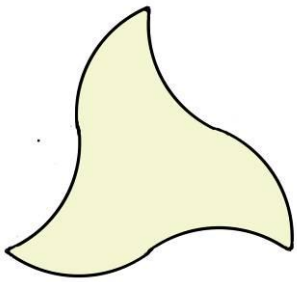
Deux translations concernant les côtés opposés.

2- La rotation :

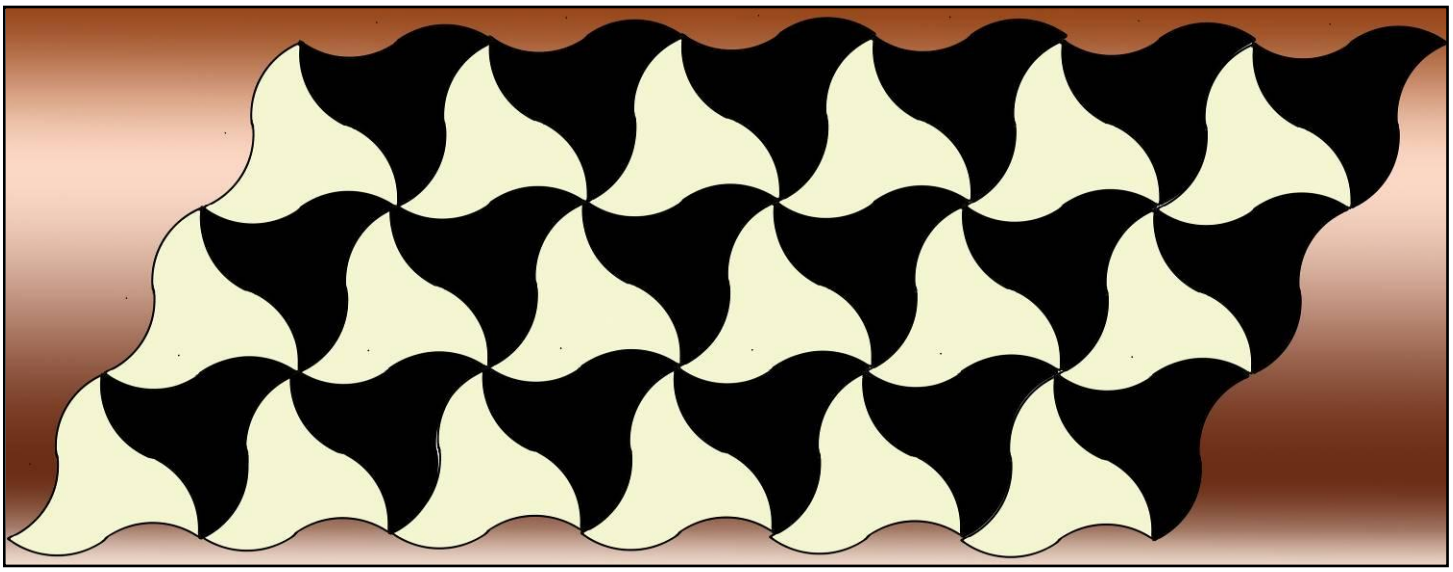
Conditions : le centre de rotation doit être situé sur la frontière en général sur un des sommets du polygone ; dans le cas de la symétrie centrale (rotation à 180°) il est placé au milieu d'un des côtés.





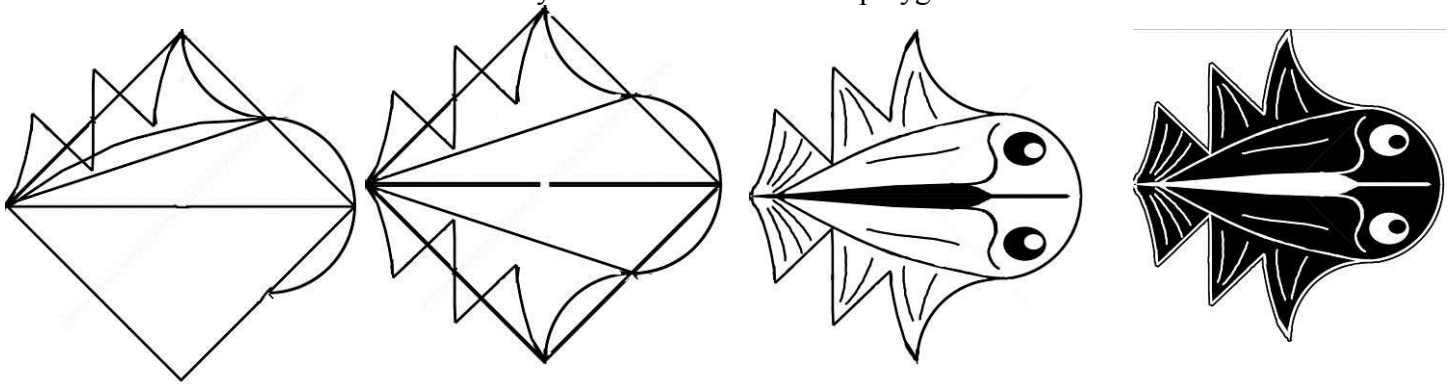


Rotation à 180° : le centre de rotation est au centre du côté concerné, suivi de deux rotations à 60°de l'ensemble du côté.

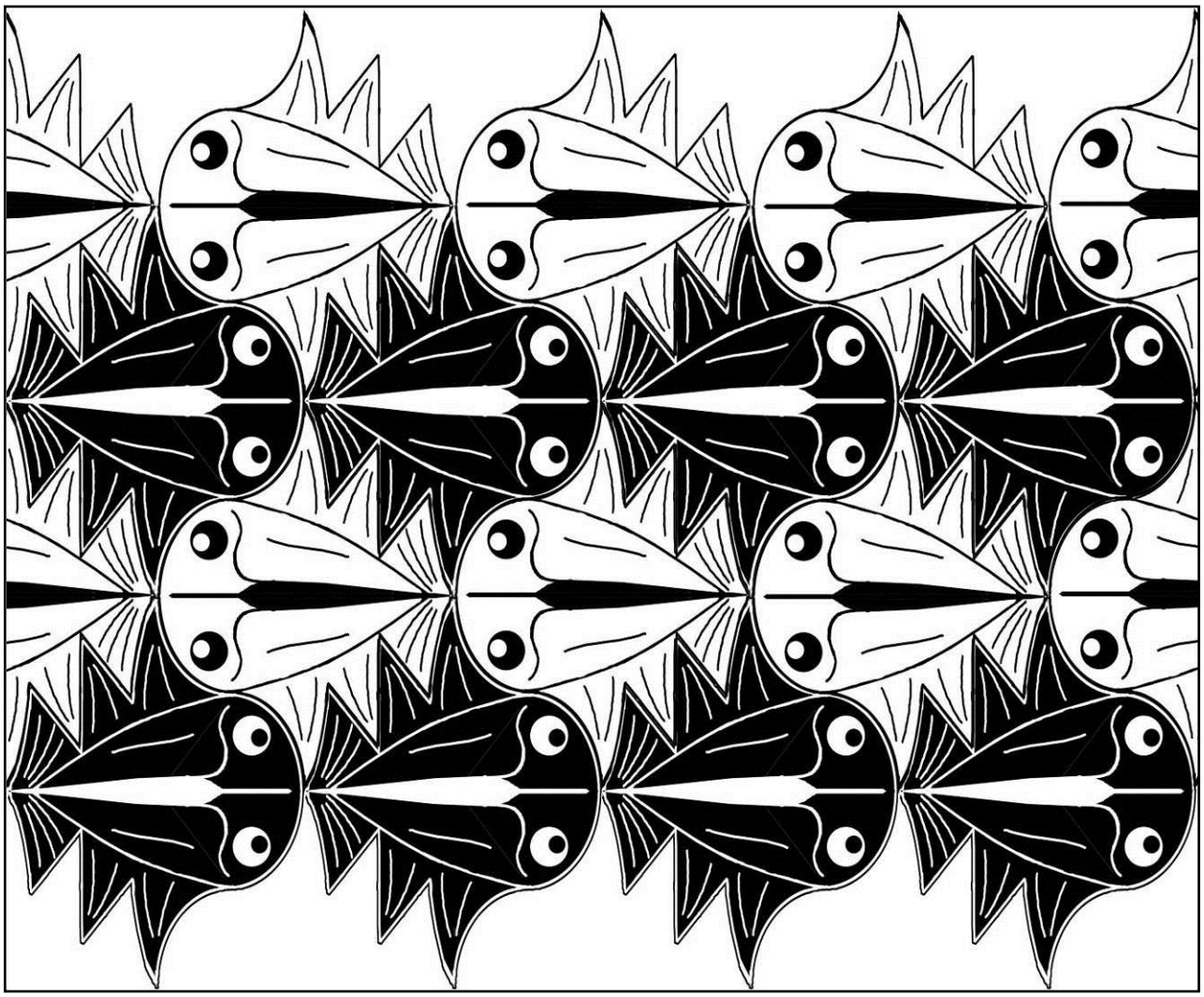


3- La symétrie :

Conditions : l'axe de symétrie doit être hors du polygone ou sur sa frontière.



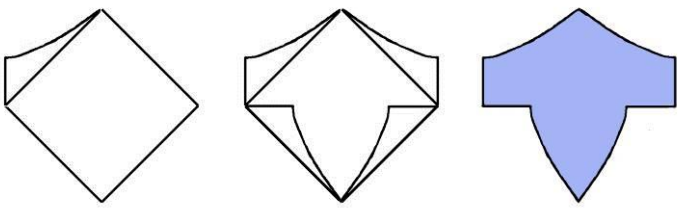
La demi figure (demi carré) est tracée avec deux symétries axiales ; la diagonale du carré sert d'axe de symétrie pour finaliser le tracé.



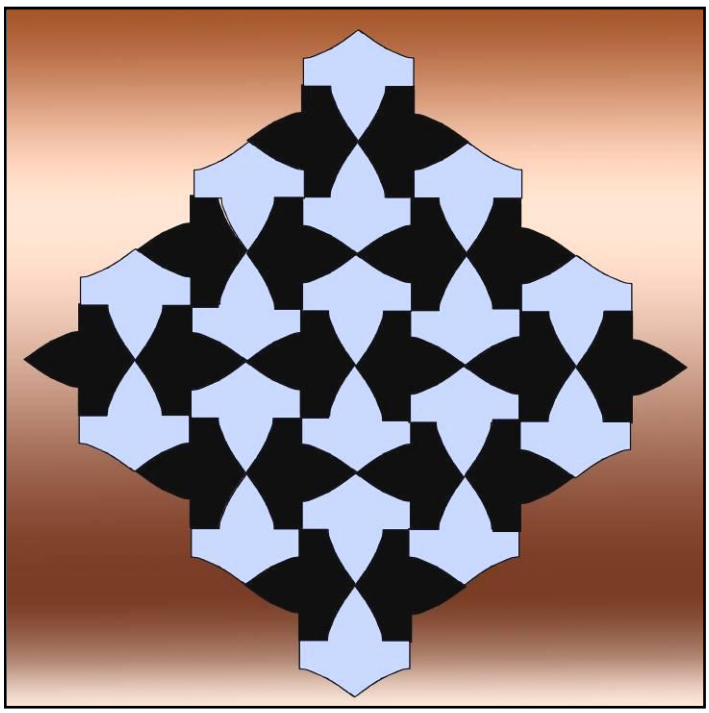
4- La réflexion glissée :

La réflexion glissée est la composante de deux isométries : la rotation et la translation.

La symétrie glissée est le résultat d'une rotation, d'une translation et d'une symétrie.



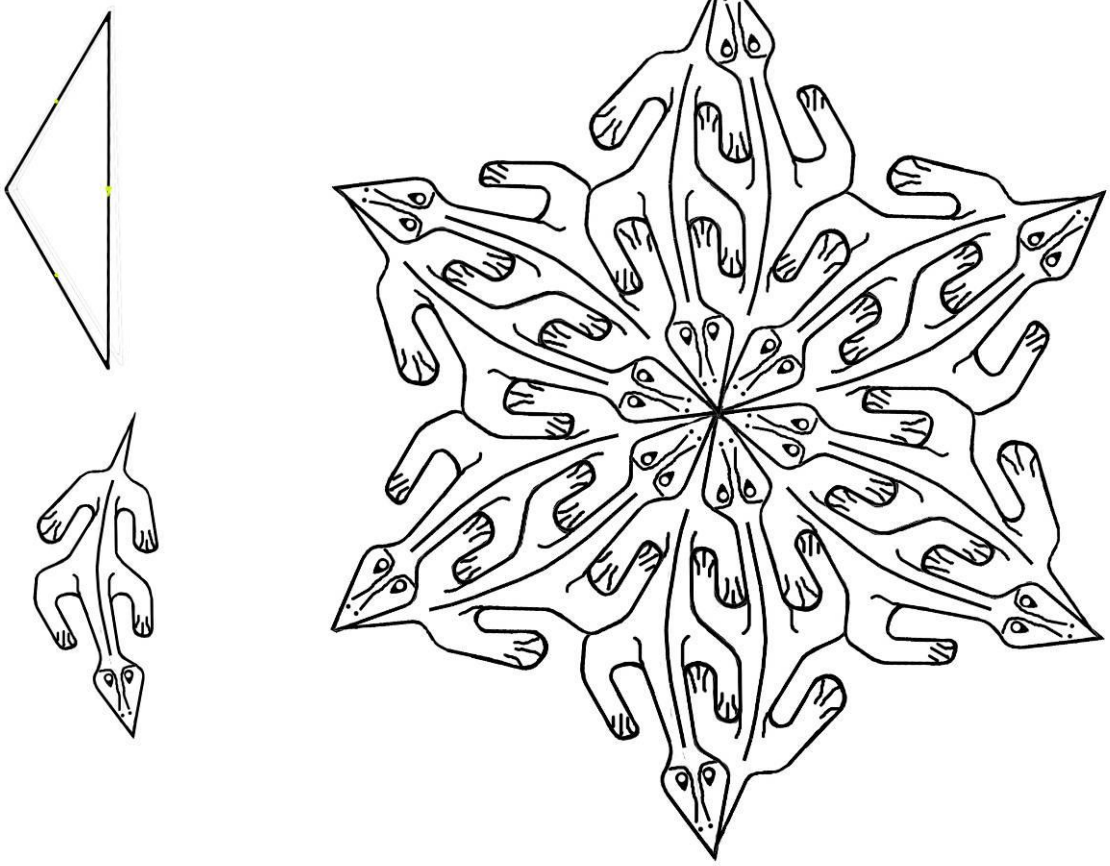
Une rotation à 90° suivie de deux réflexions glissées.

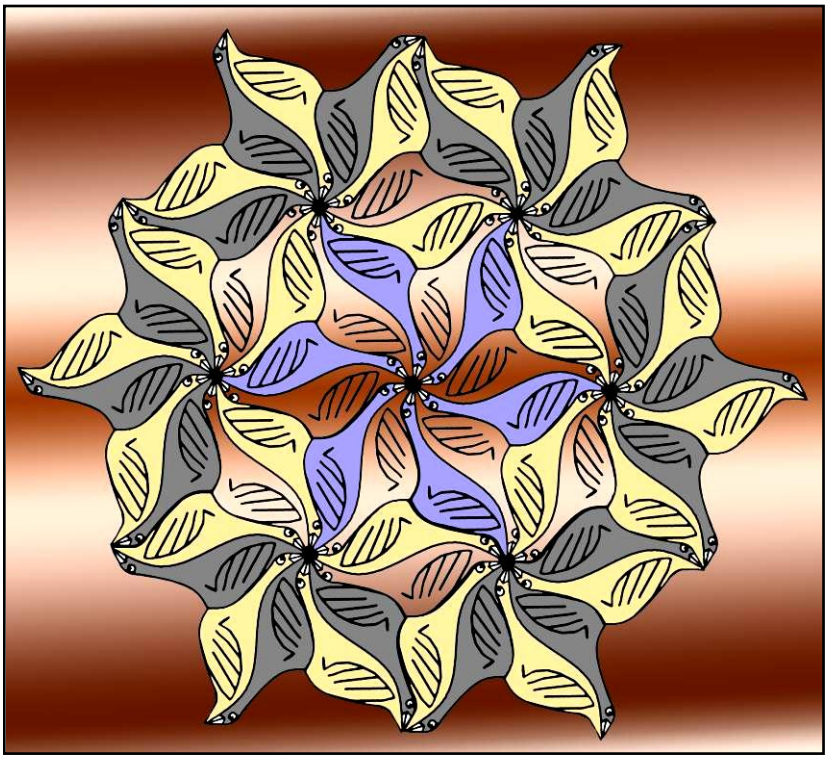


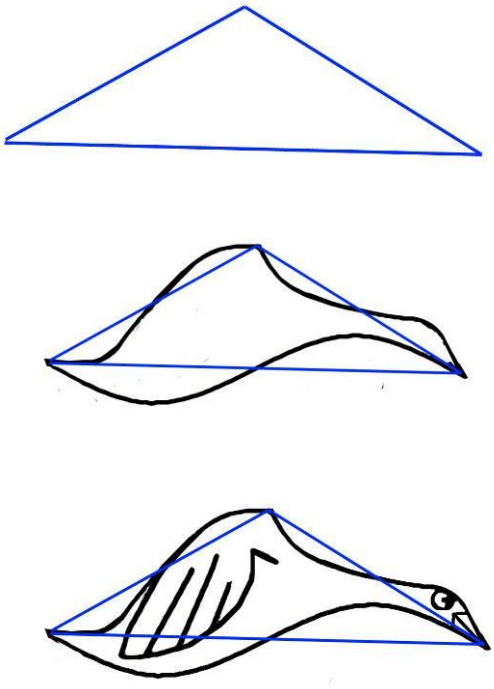
d) Pavage de polygones irréguliers :

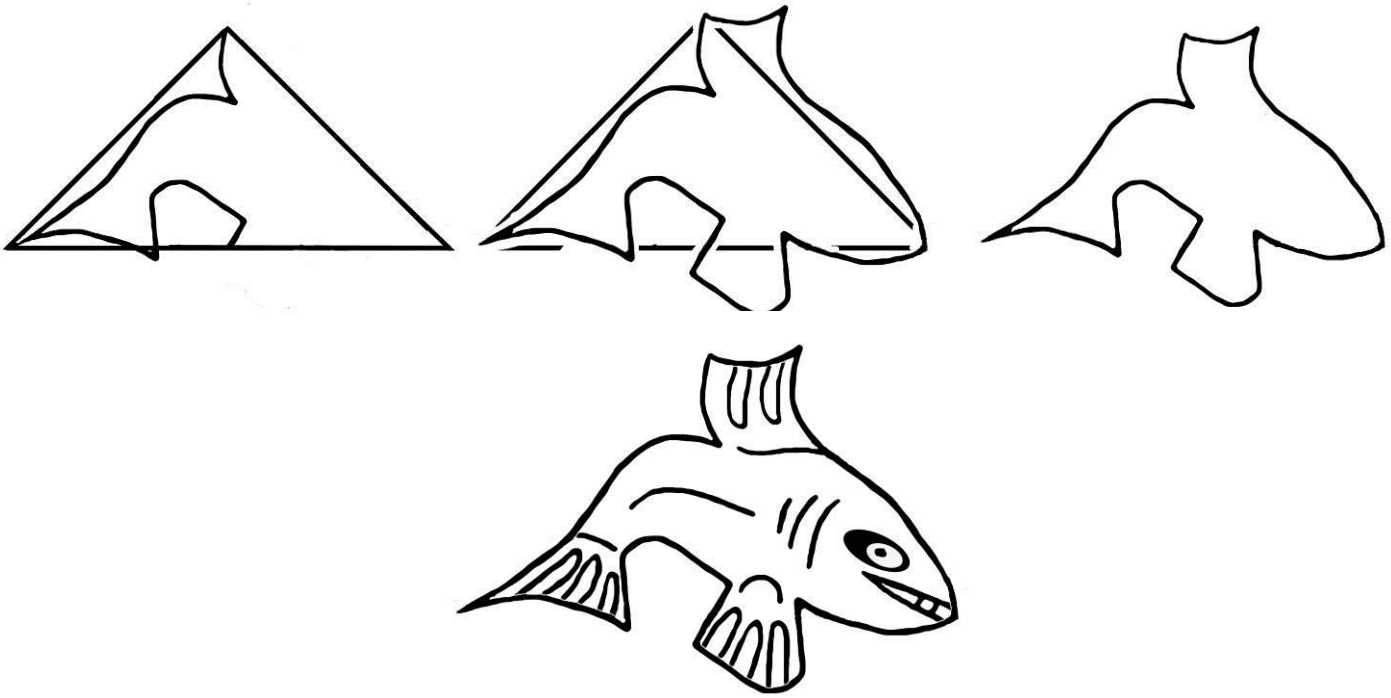
1- Triangle quelconque :

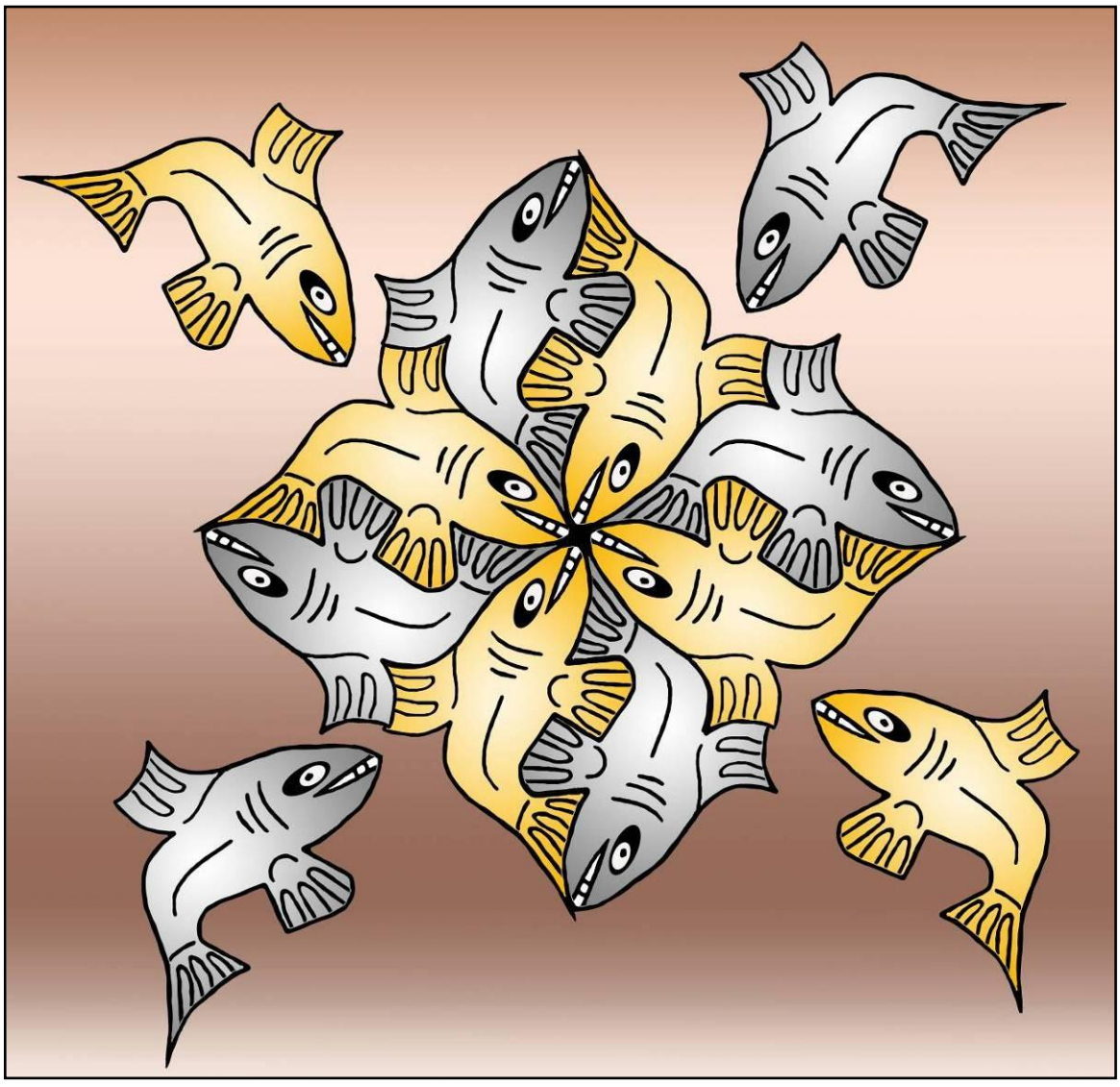
Tous les triangles pavent le plan : ci dessous : un lézard, une oie et un requin.





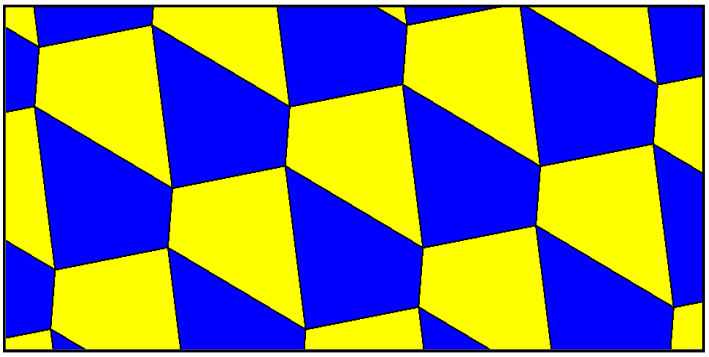


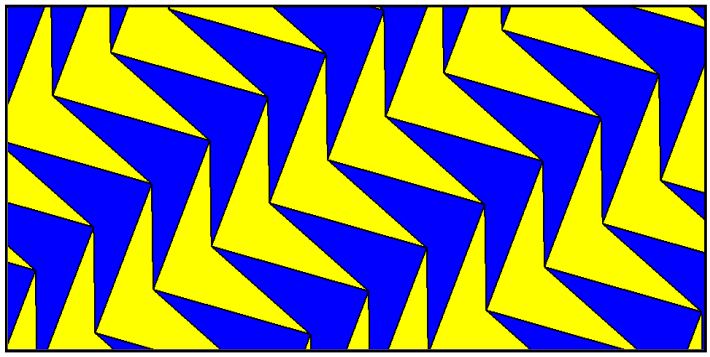


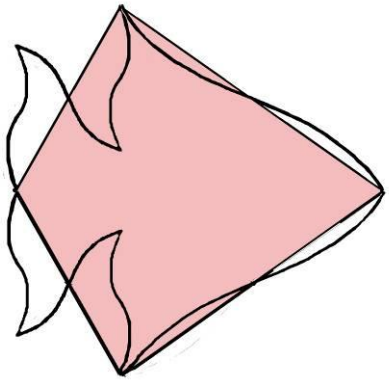


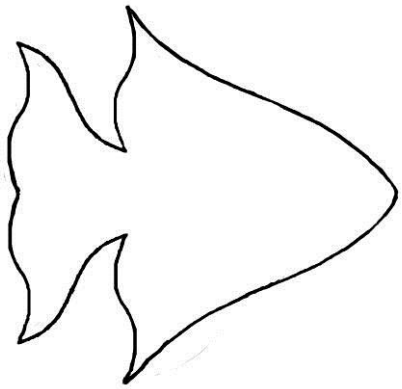
2- Les quadrilatères :

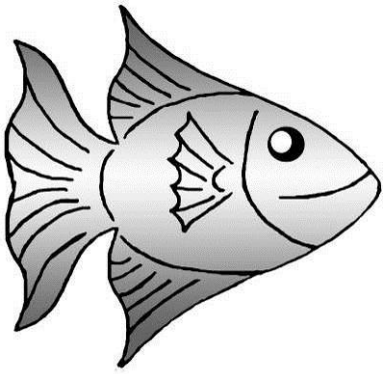
Tous les quadrilatères pavent le plan.

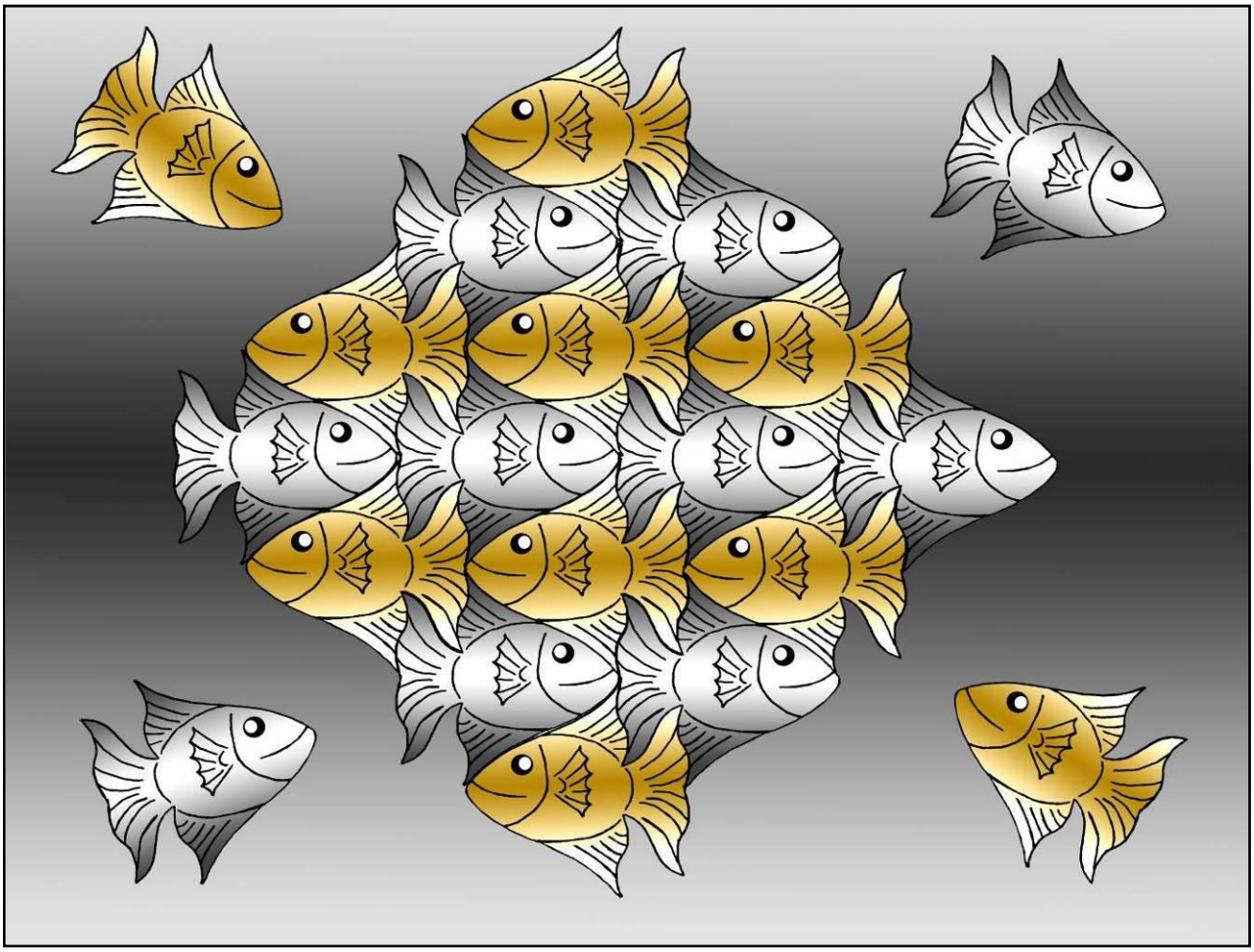


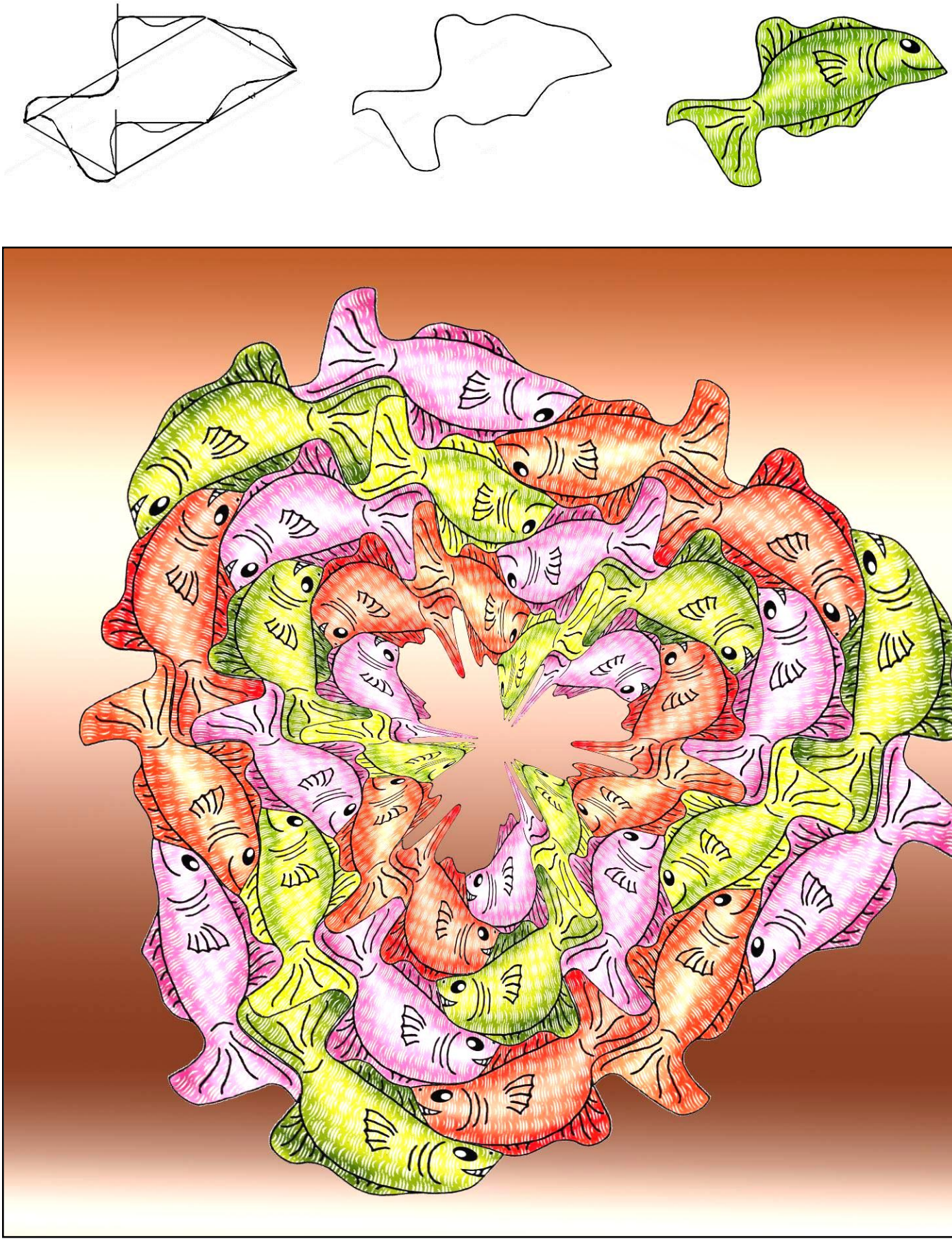






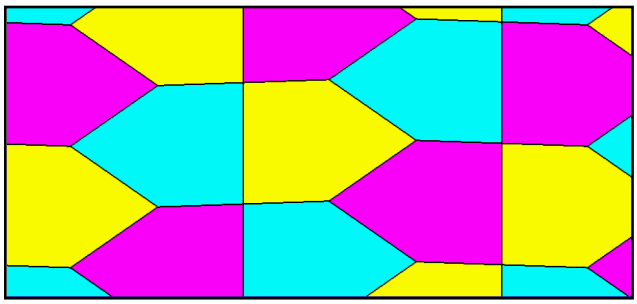




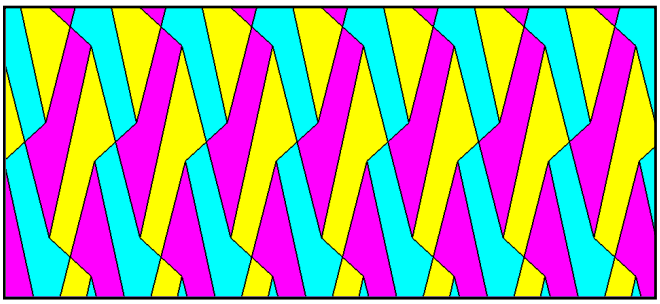


3- Les pentagones :

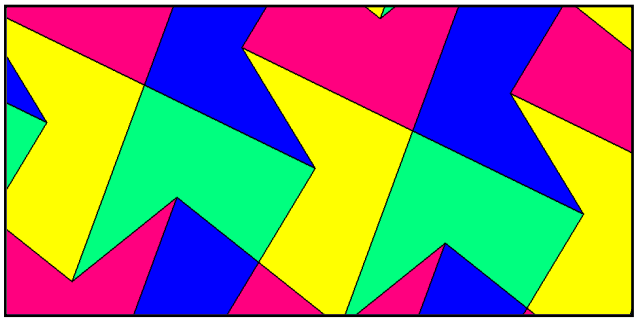
Les pentagones réguliers ne pavent pas le plan ; par contre, certains pentagones irréguliers pavent le plan. La recherche des propriétés de ces pentagones irréguliers (relation entre les côtés et les angles) a occupé des mathématiciens chevronnés pendant longtemps ; toutes les solutions n'ont pas encore étés résolues et quand certains trouvent ferment le dossier, il y a toujours un plaisantin qui en trouve une nouvelle. A ce jour 15 solutions se présentent, à quand une nouvelle ?

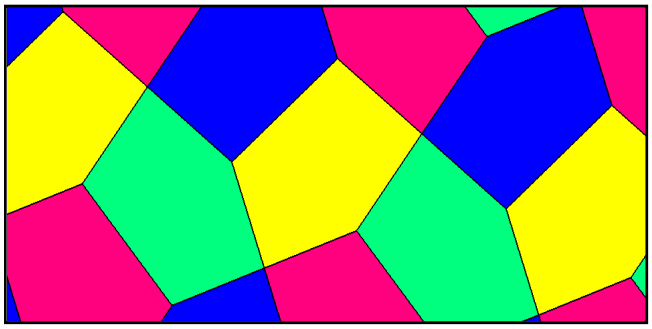


Deux Côtés opposés parallèles et deux côtés consécutifs isométriques.

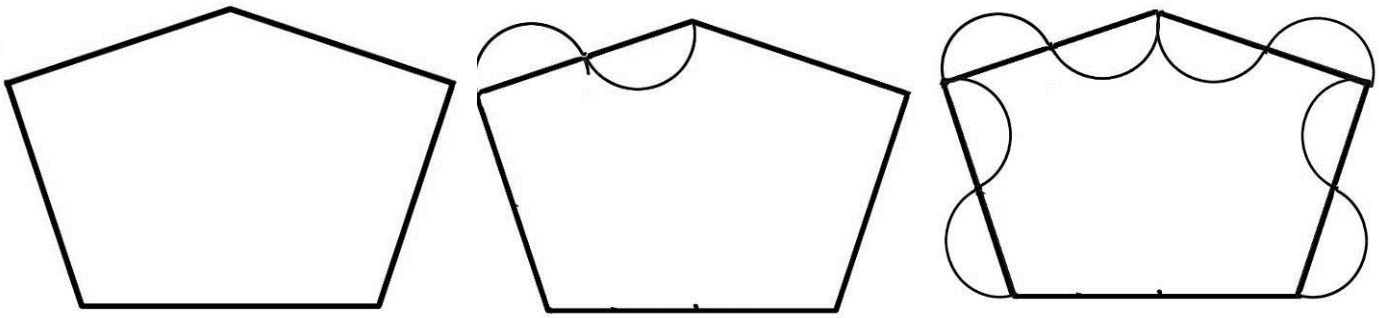


Les côtés alternés isométriques deux à deux.

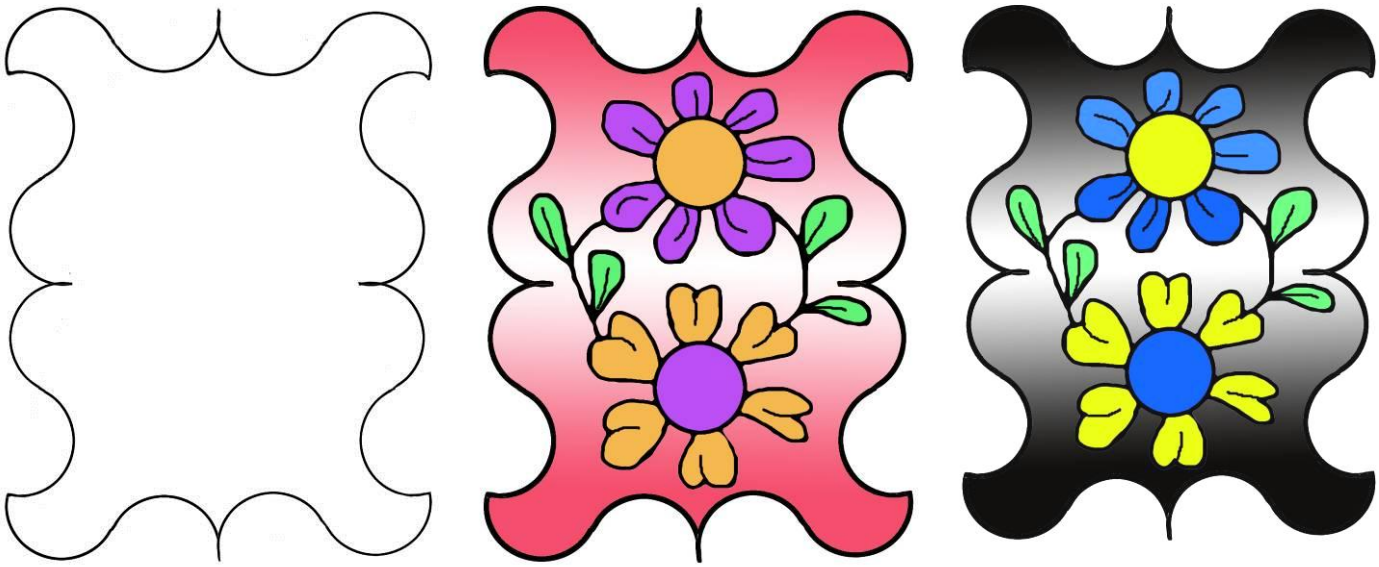


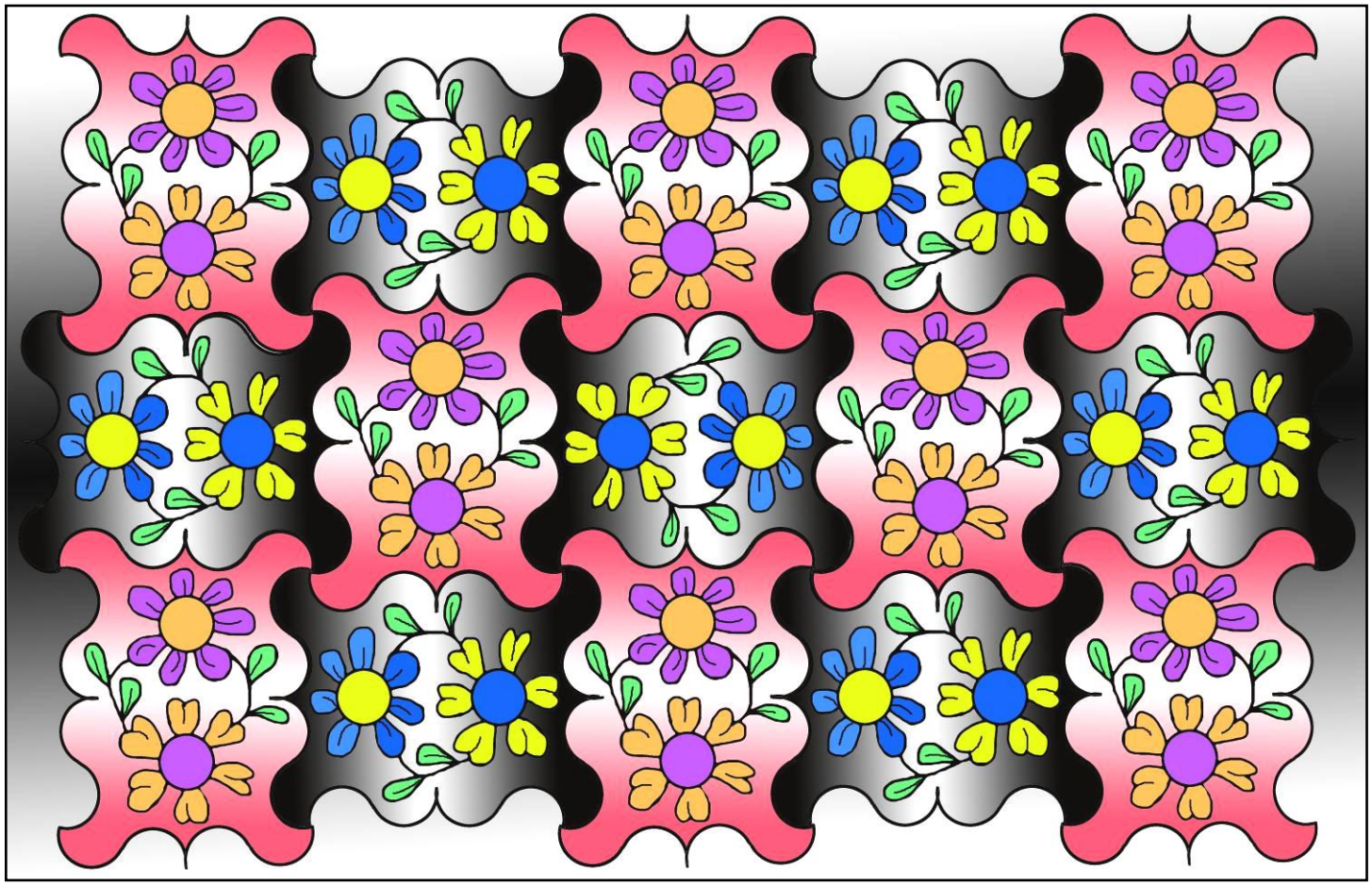


Côtés consécutifs isométriques deux à deux.



Pavage du Caire : Deux côtés opposés et deux côtés consécutifs isométriques.

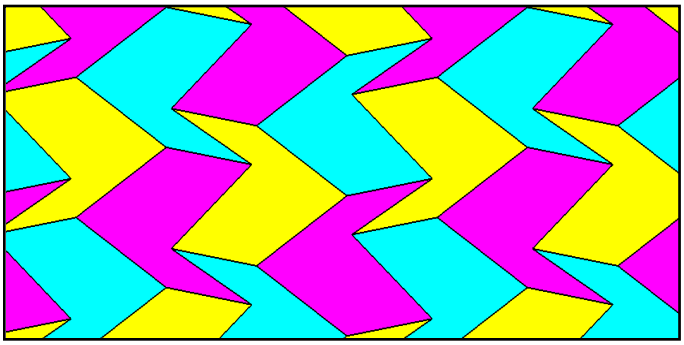


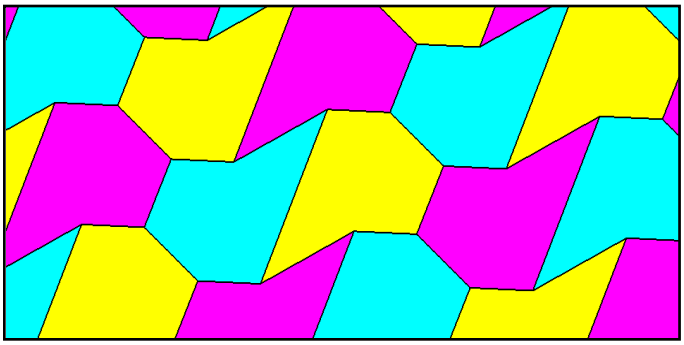


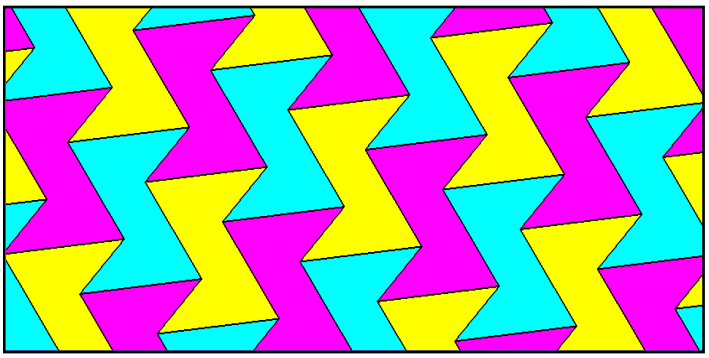
4- Les hexagones.

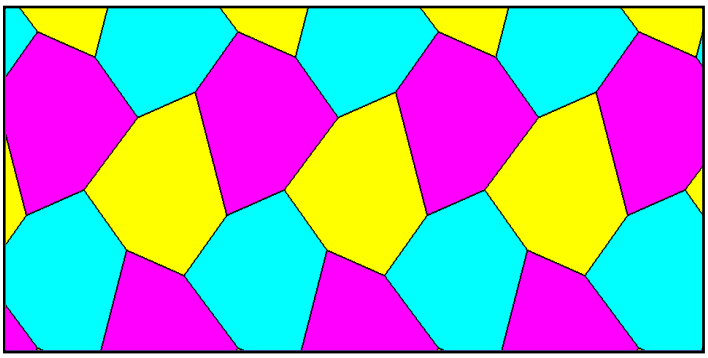
Le pavage avec un hexagone irrégulier est possible sous certaines conditions en fonction des côtés (isométriques ou parallèles) et de la valeur des angles.

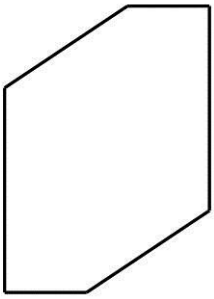
CONSTRUCTION

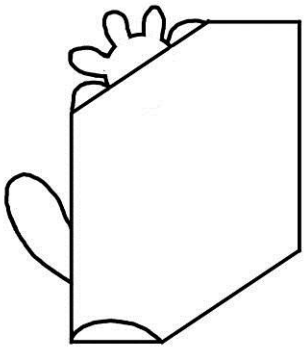


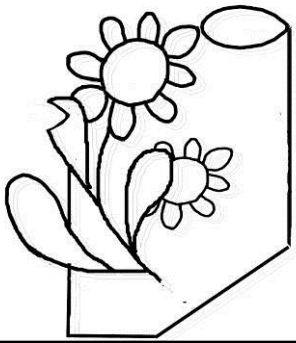


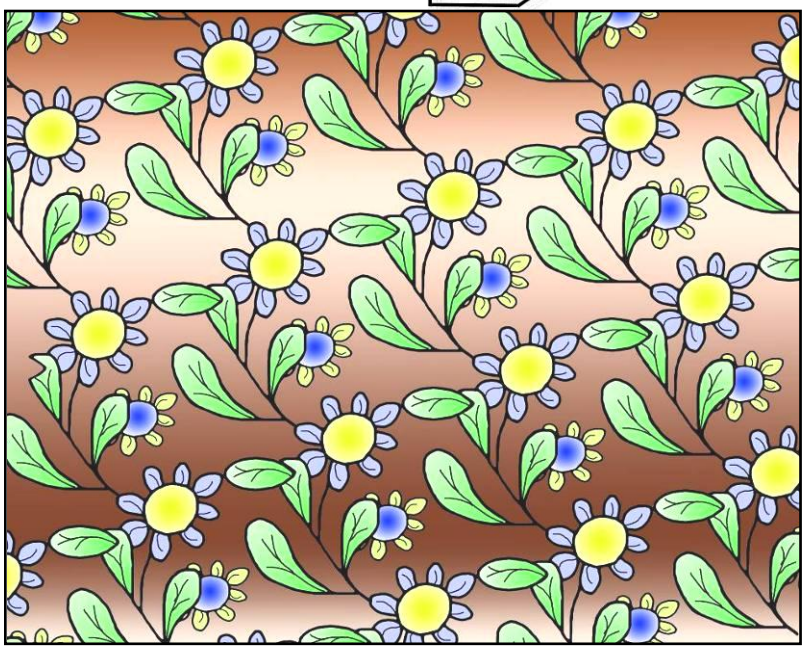








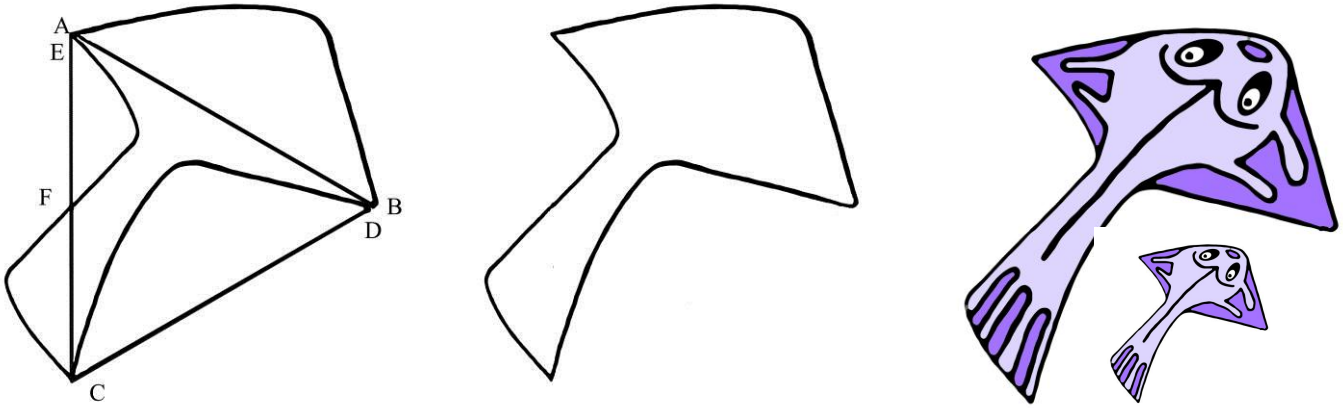




II. De l'infiniment grand à l'infiniment petit :

En partant du pavé, quelle que soit sa taille (il peut être très grand ou tout petit), le pavé diminue de moitié ou augmente à chaque niveau. Nous nous plaçons évidemment à notre niveau de perception. Il s'agit en fait de construire la partie d'une fractale.

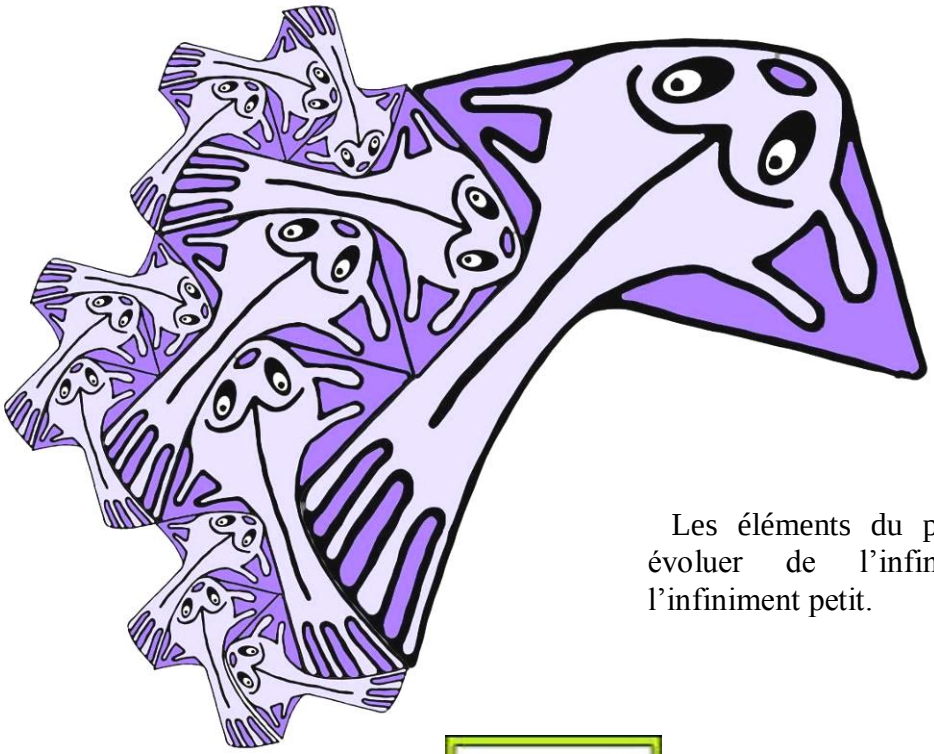
La construction de ce type de pavé obéit à des règles strictes néanmoins simples.



La courbe AB se retrouve en CD par une rotation à gauche de 60°.

La courbe AB se retrouve en EF, à l'**échelle un demi**, par une rotation à droite de 60°.
C'est ce changement d'échelle qui permettra de placer les pavés à l'**échelle un demi**.

Une symétrie centrale de centre F de la courbe EF permet de construire FC

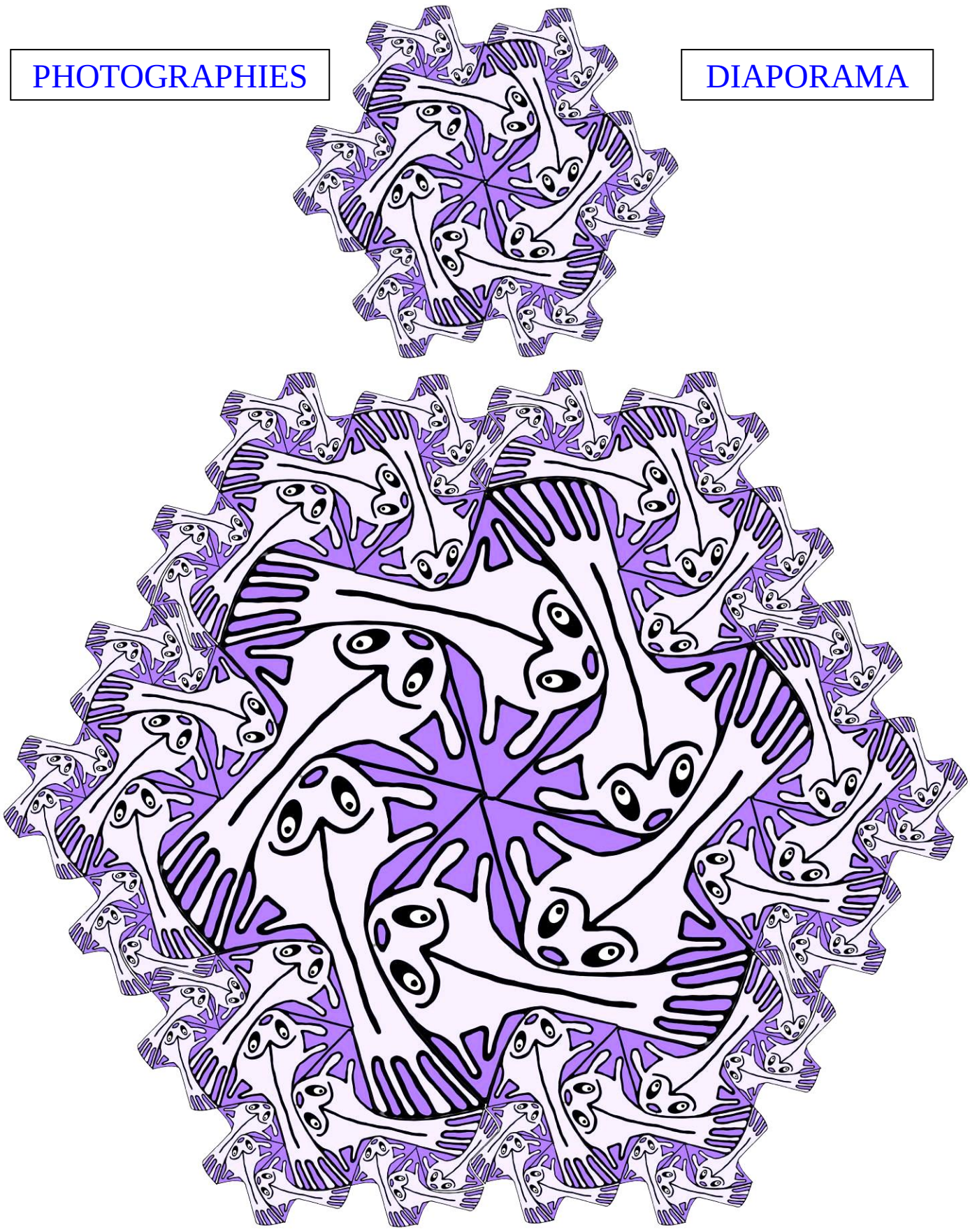


Les éléments du pavé peuvent ainsi évoluer de l'infiniment grand à l'infiniment petit.

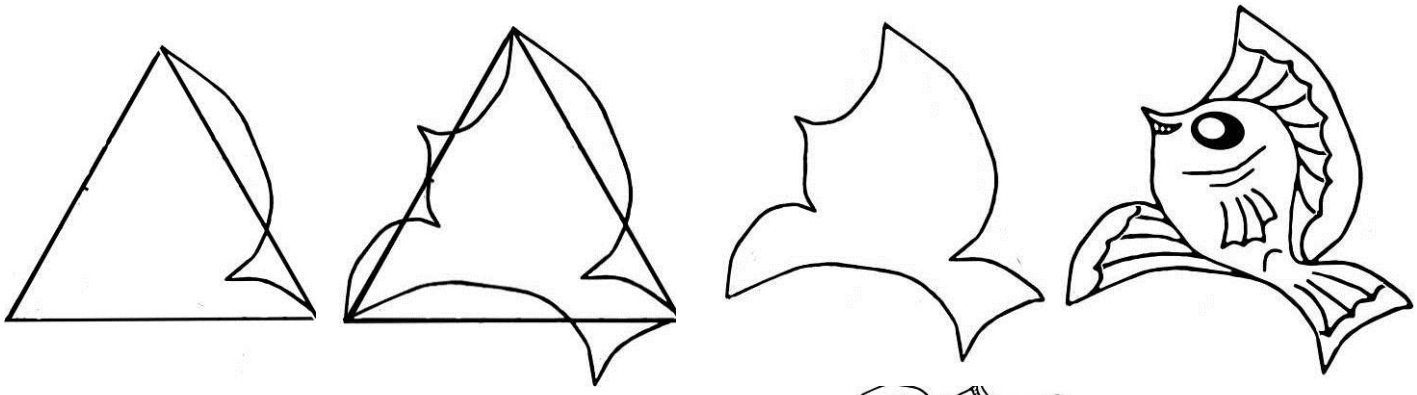
RETOUR

PHOTOGRAPHIES

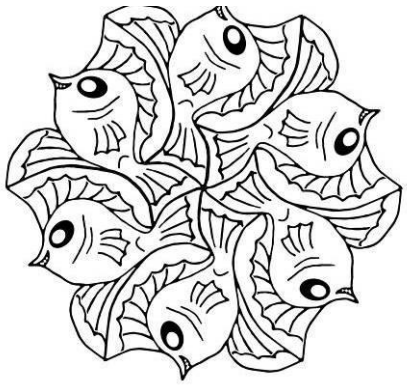
DIAPORAMA

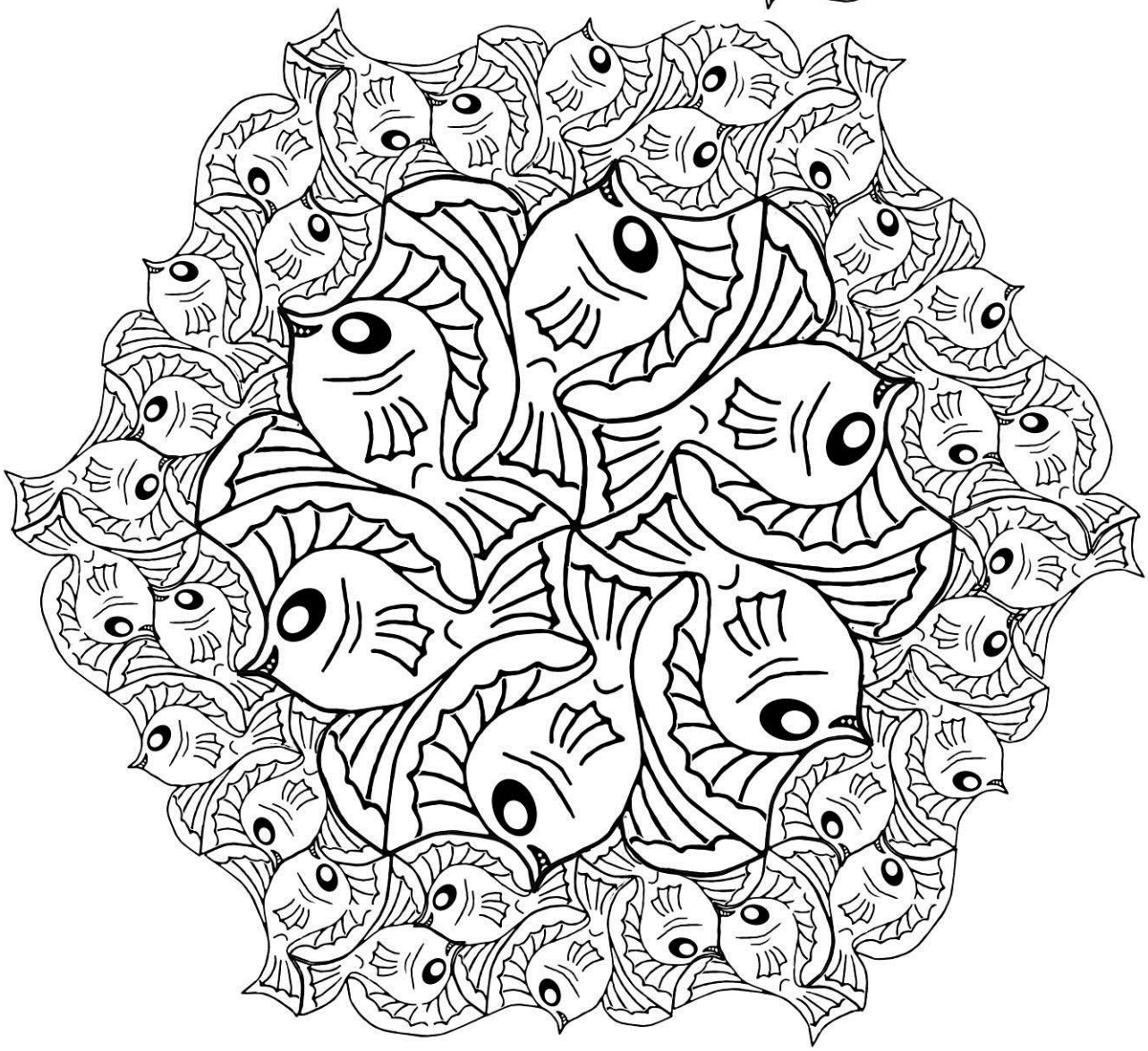


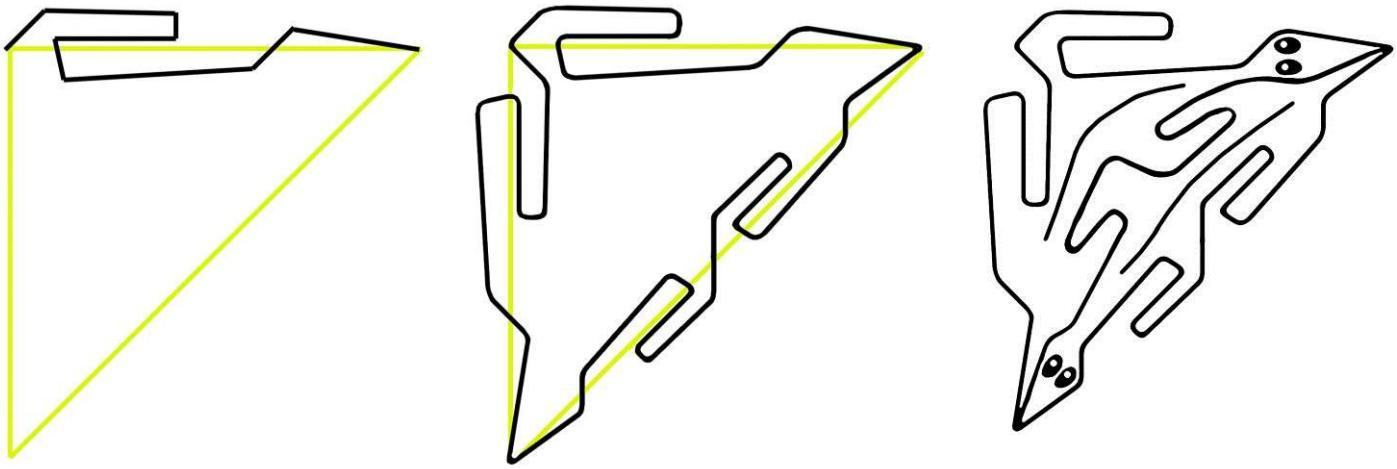
Trois niveaux de construction : la limite extérieure de l'infiniment petit sera un hexagone régulier

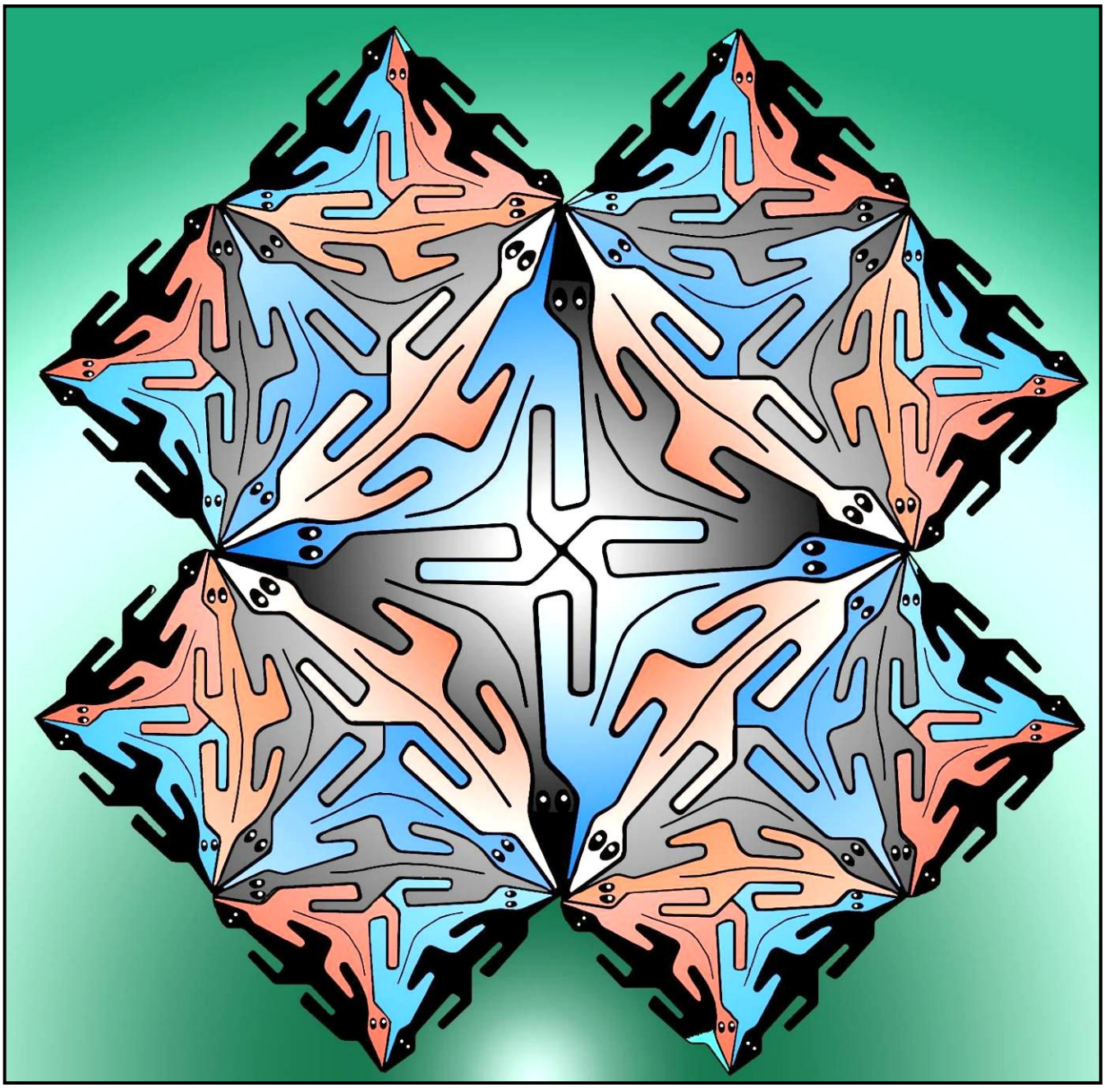


CONSTRUCTION

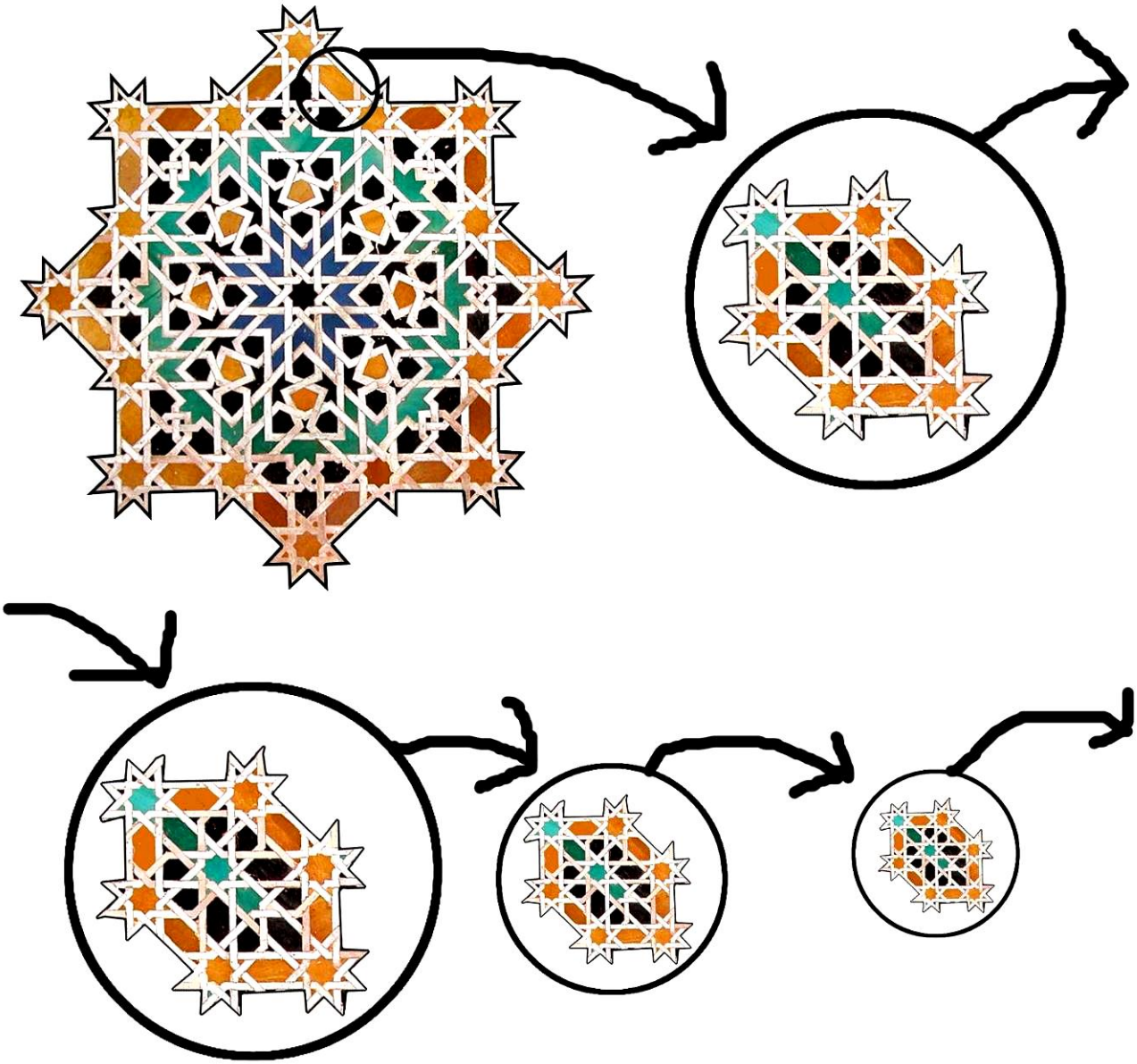




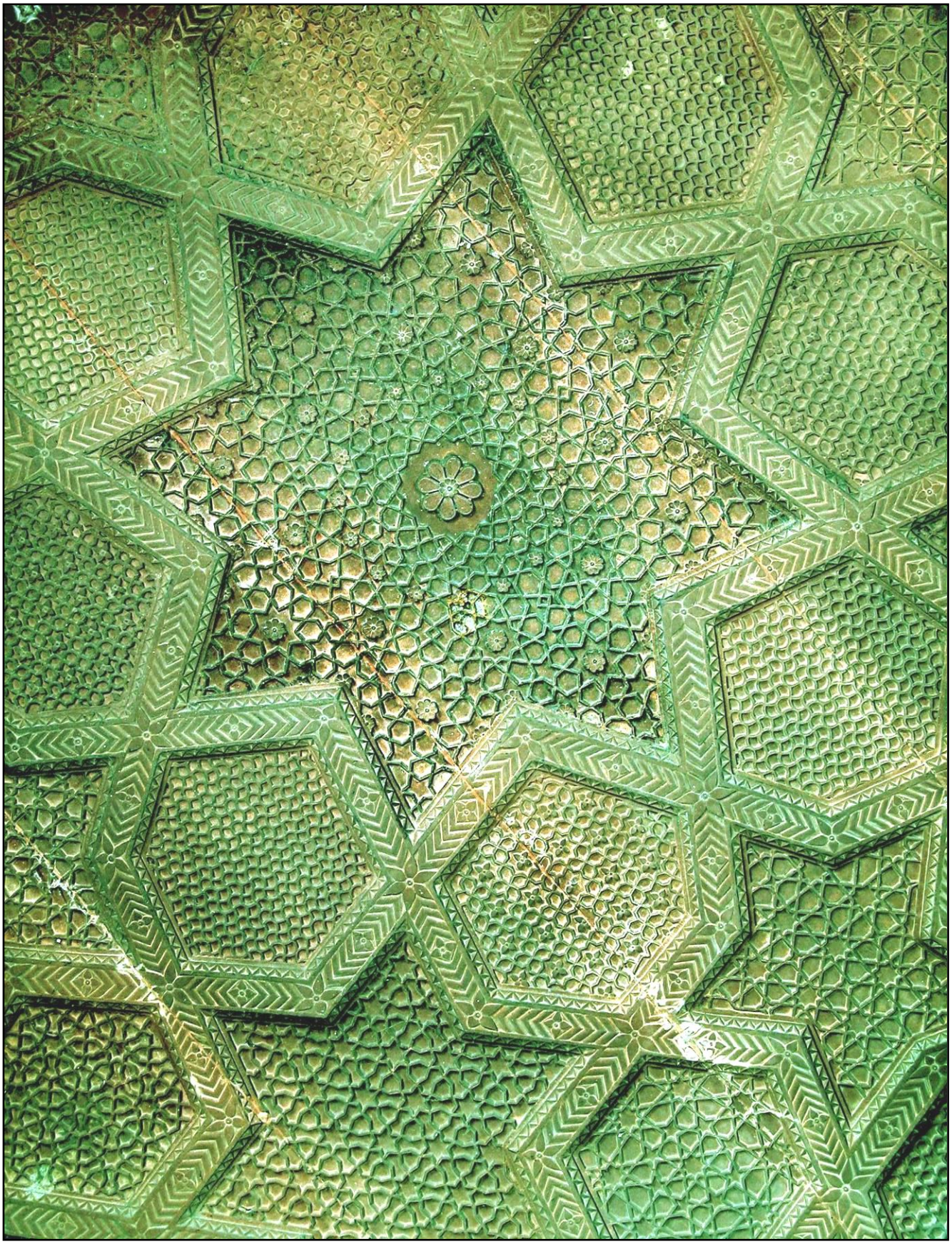




Cette approche de l'infini se retrouve aussi dans de nombreux motifs d'arabesques : par exemple le saft de ce panneau de zelliges de l'Alhambra de Grenade peut se conjuguer jusqu'à l'infini.



De même pour cette étoile de Fathepur Sikri, elle-même formée de deux étages d'éléments : on peut rajouter autant de niveaux que l'on veut à cette structure.

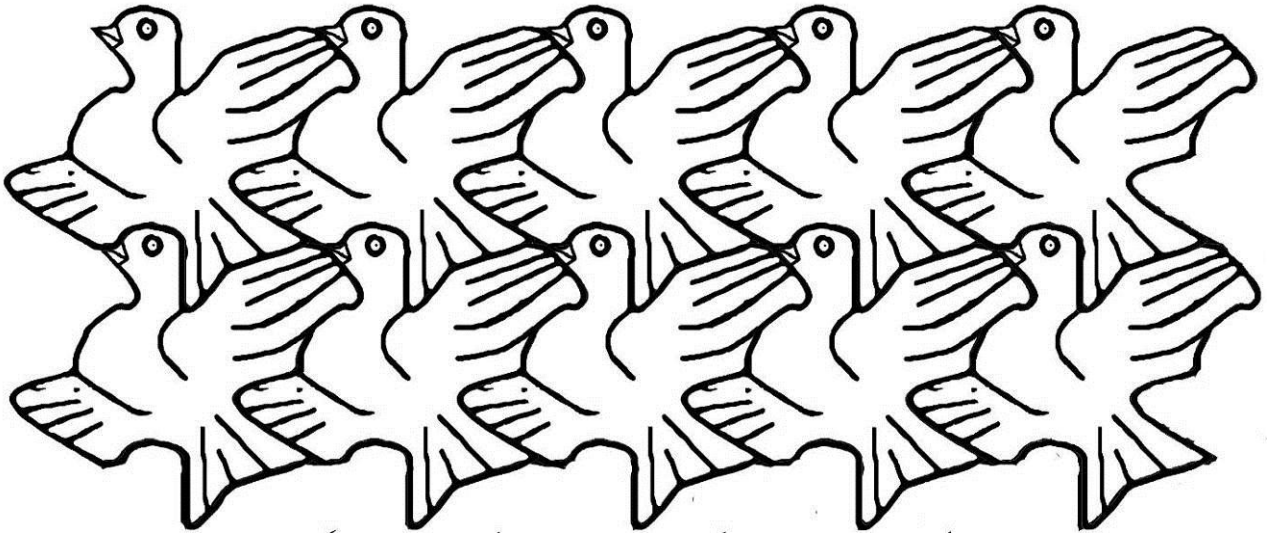


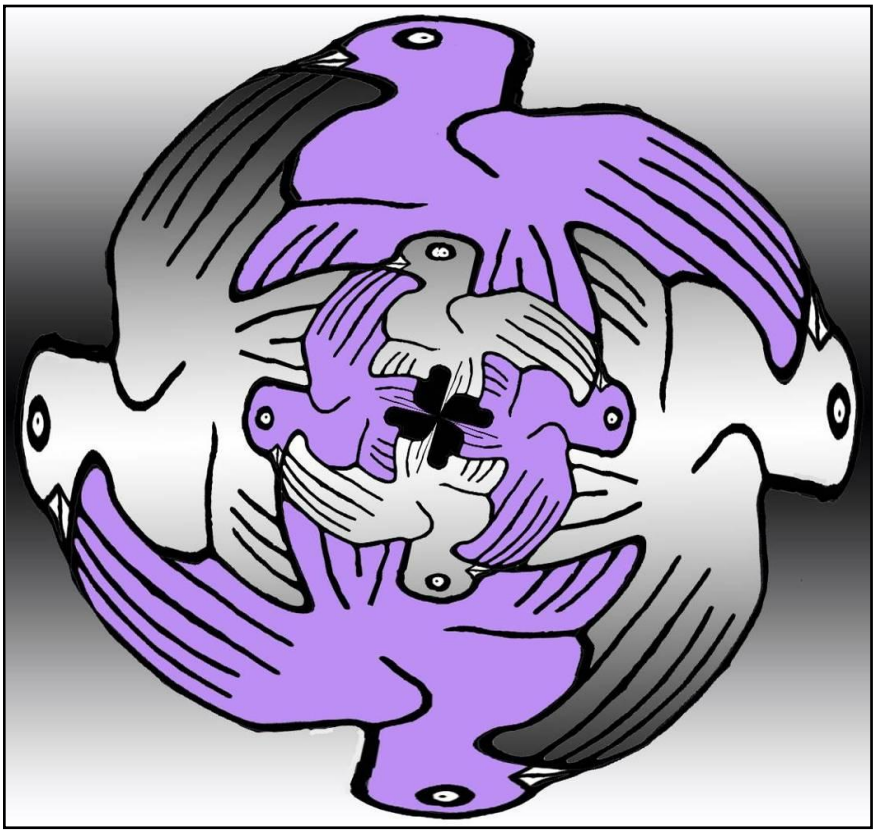
PHOTOGRAPHIES DIAPORAMA

III. Déformations polaires :

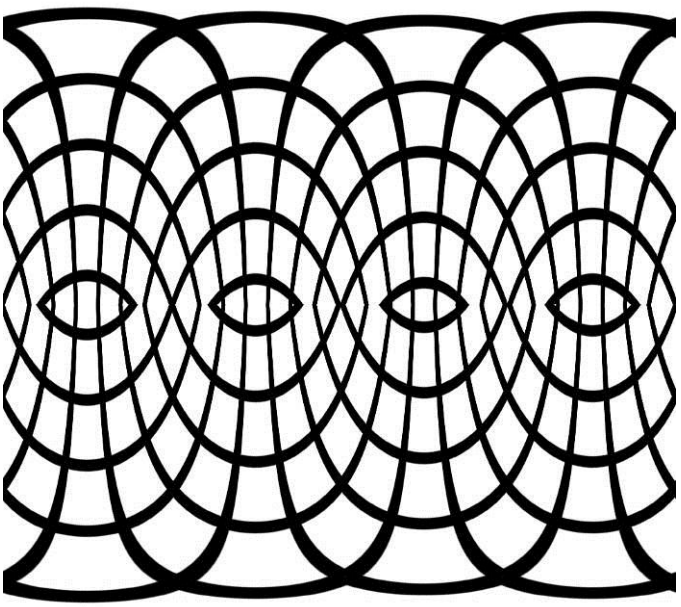
Le côté mathématique de la géométrie polaire étant laissé de côté, seules les déformations polaires seront étudiées. Le tripatouillage des coordonnées polaires nous permet, sous certaines conditions, de transformer un cercle en droite et vice-versa ; nous pouvons donc :

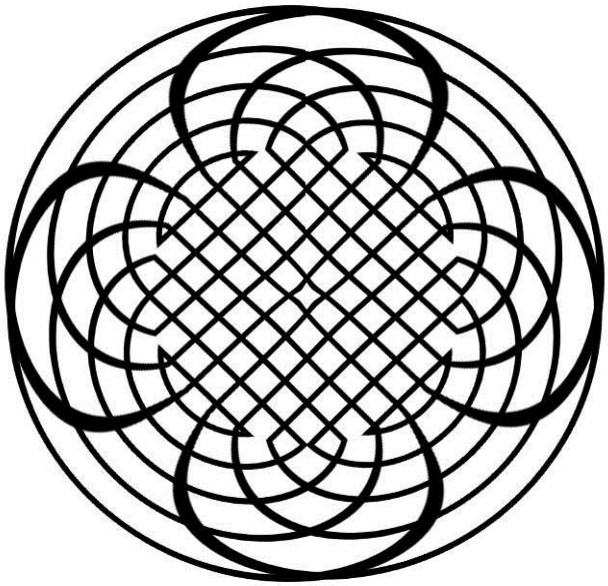
a) Transformer une frise en rosace :

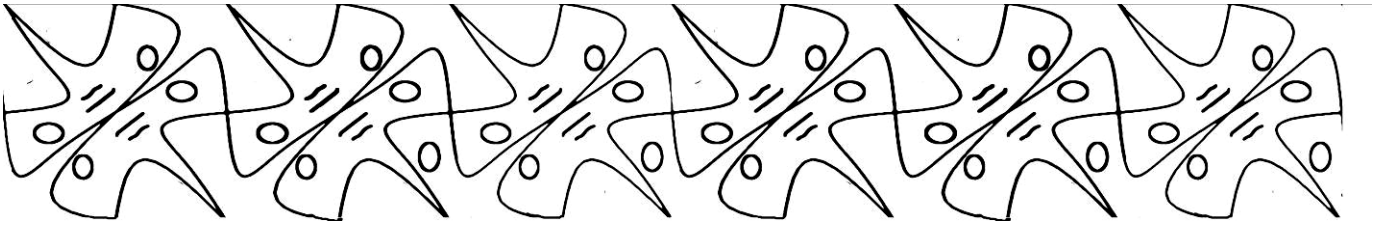


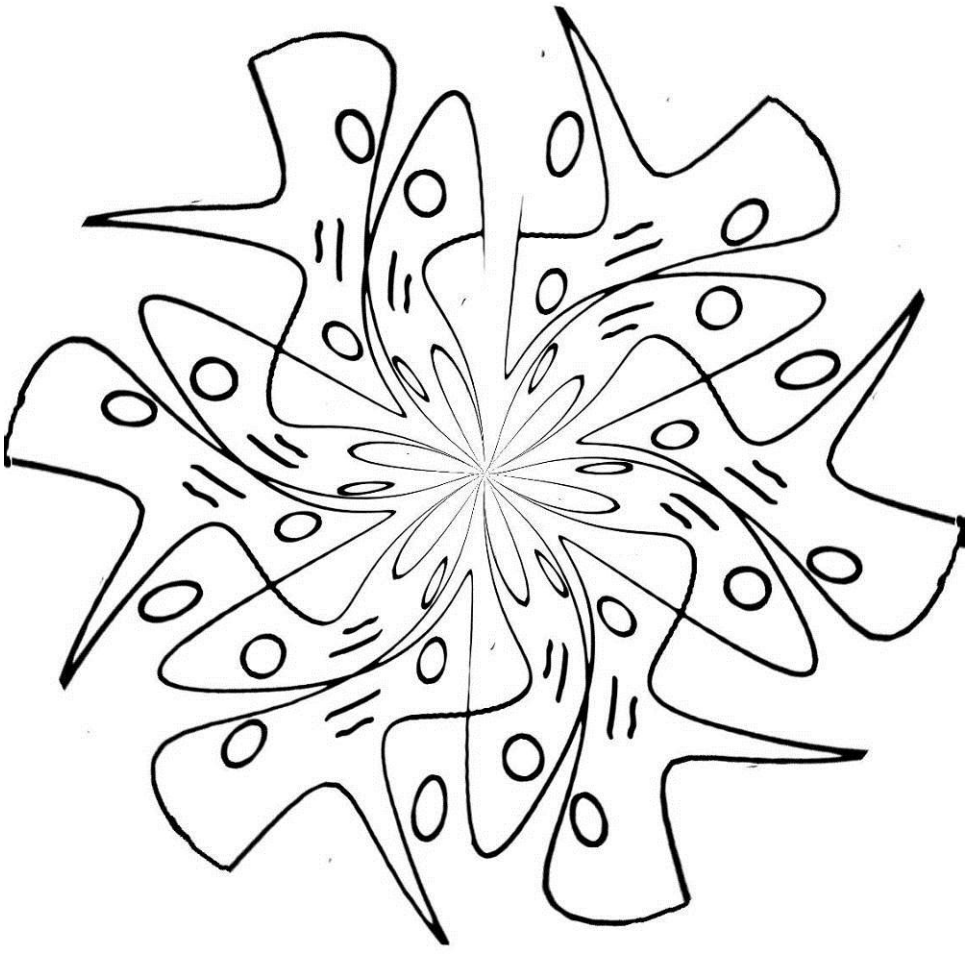


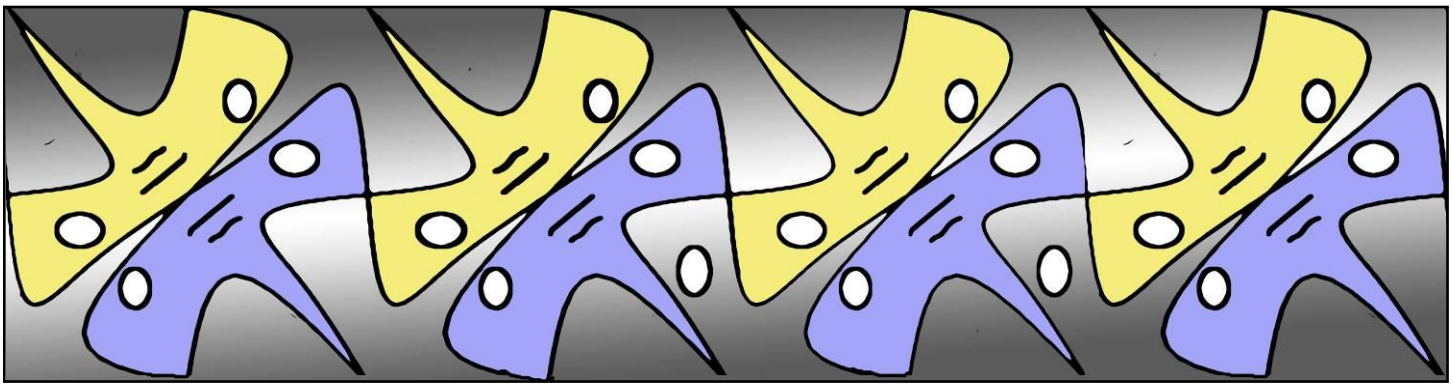
RETOUR

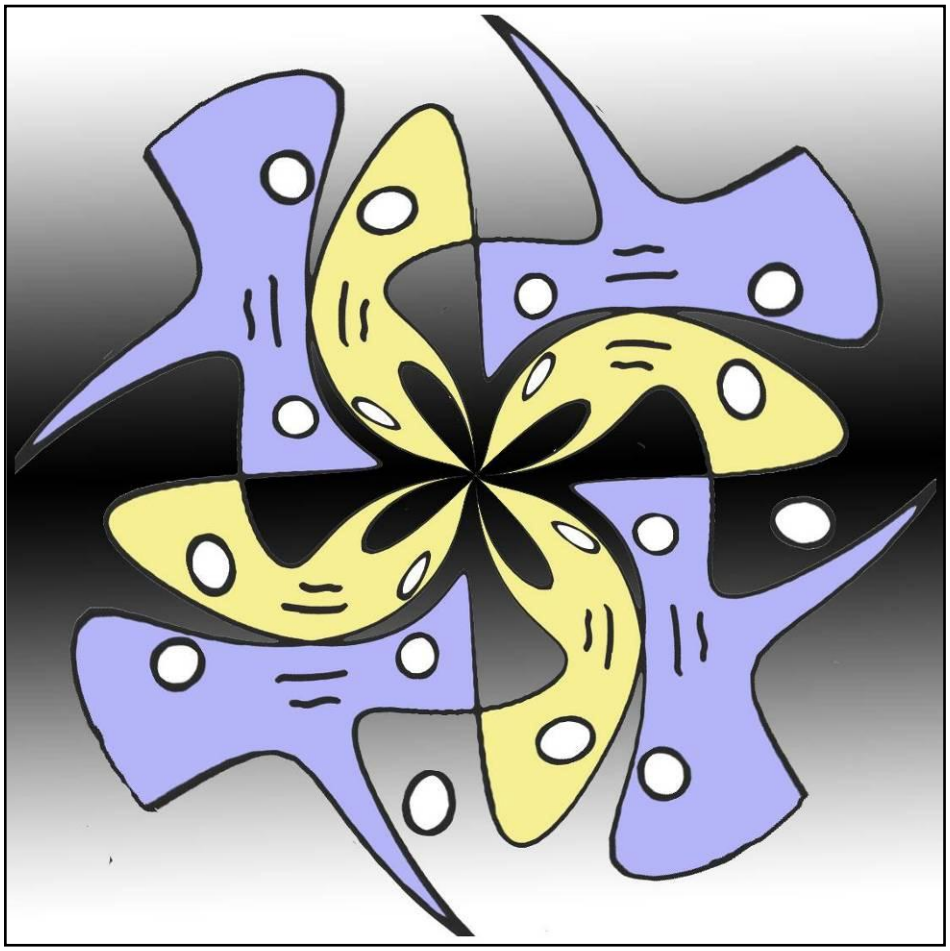




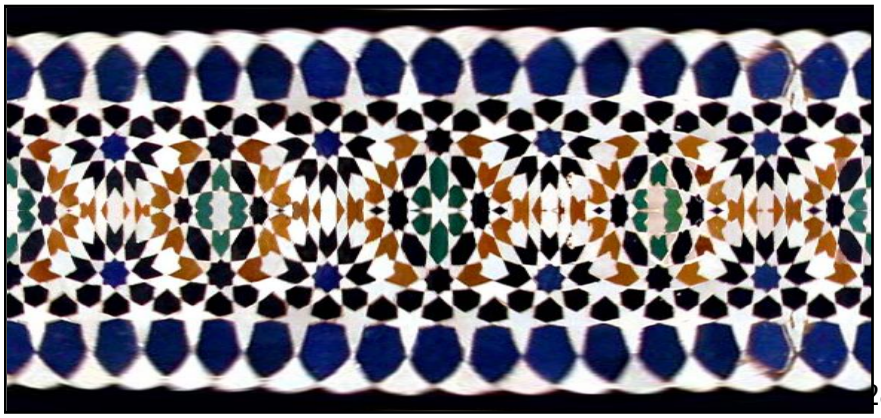




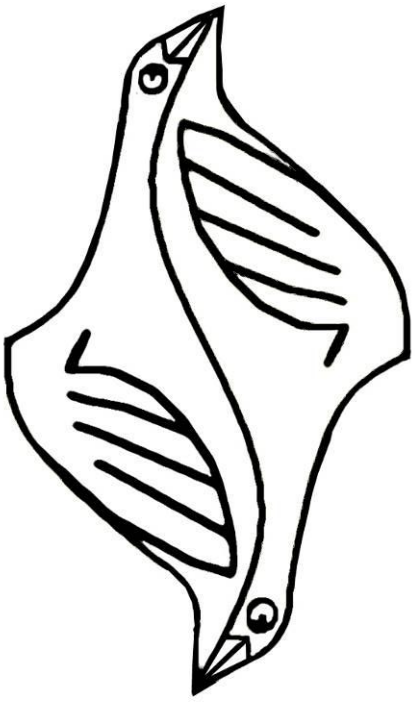


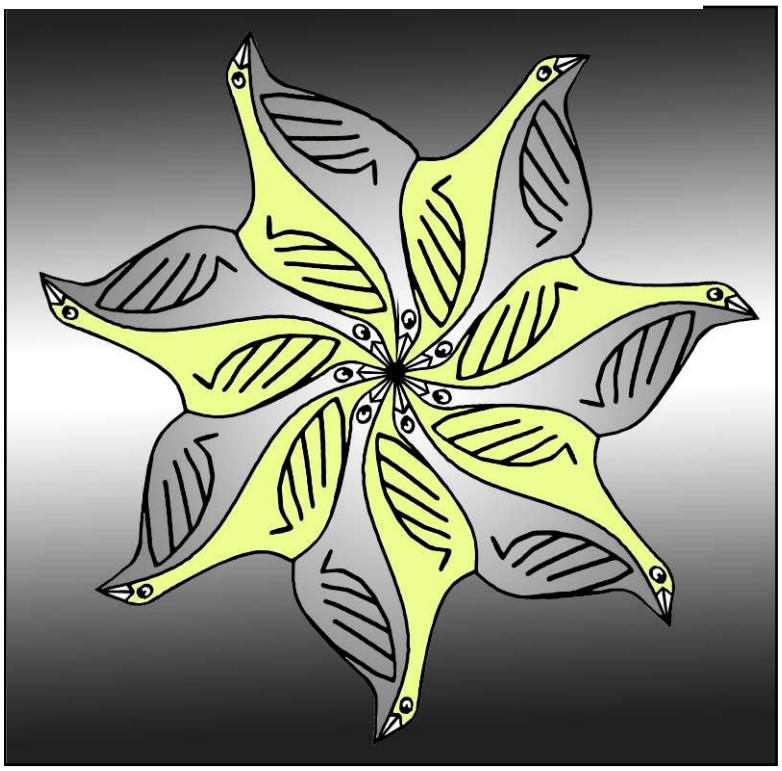


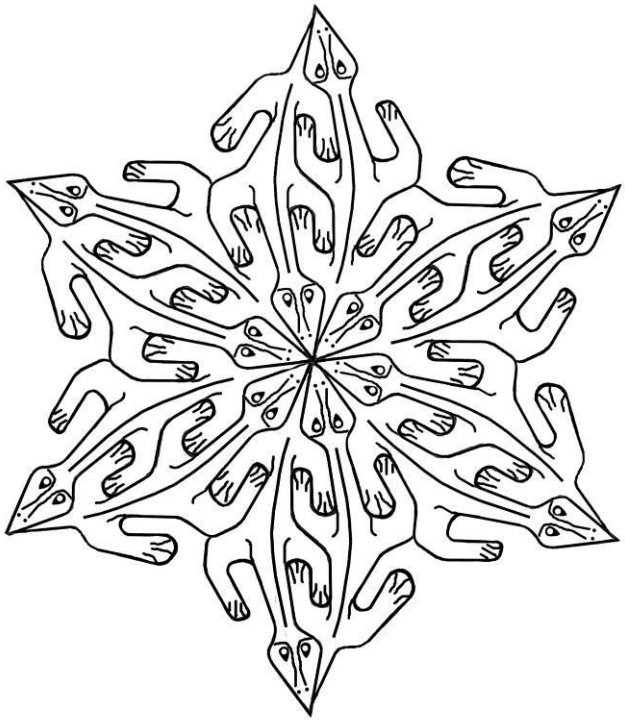
b) Transformer une rosace en frise.

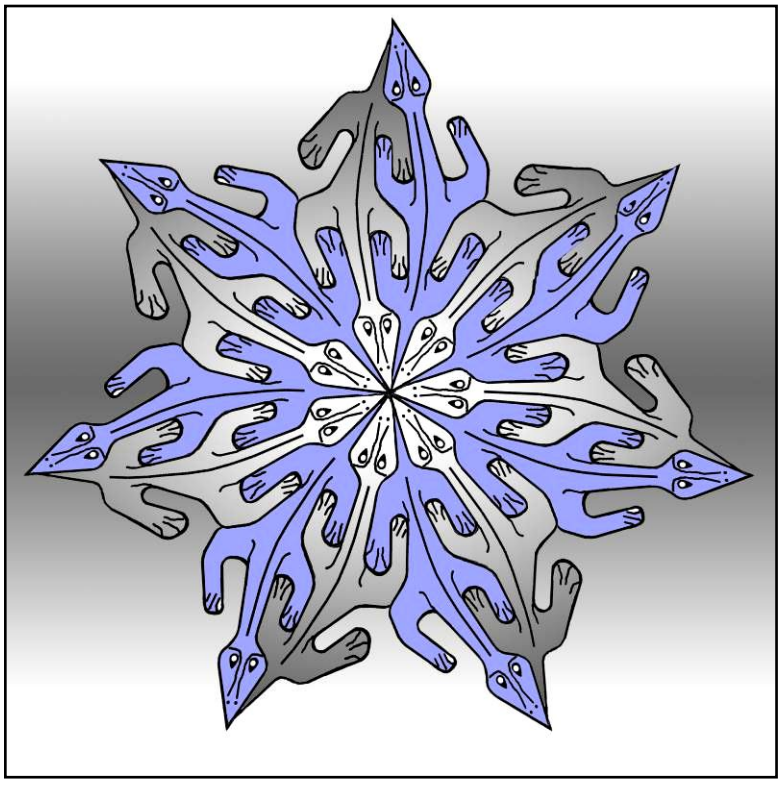


c) Ajouter un élément à une rosace :





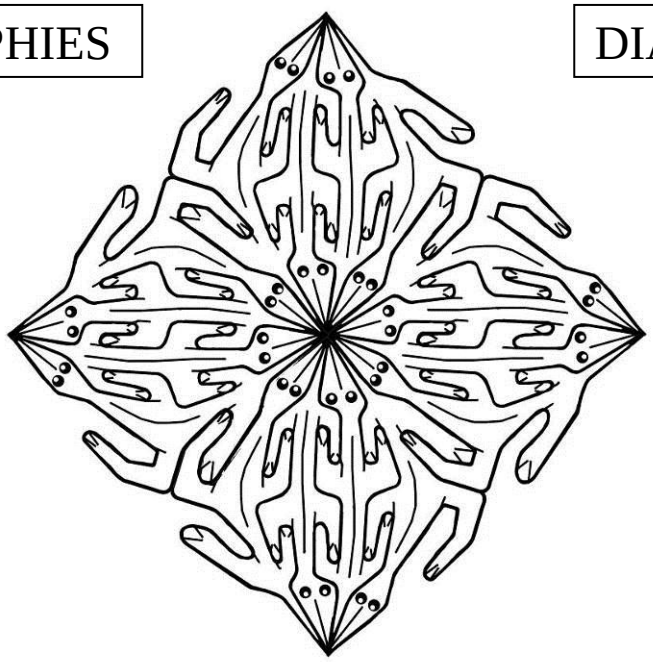


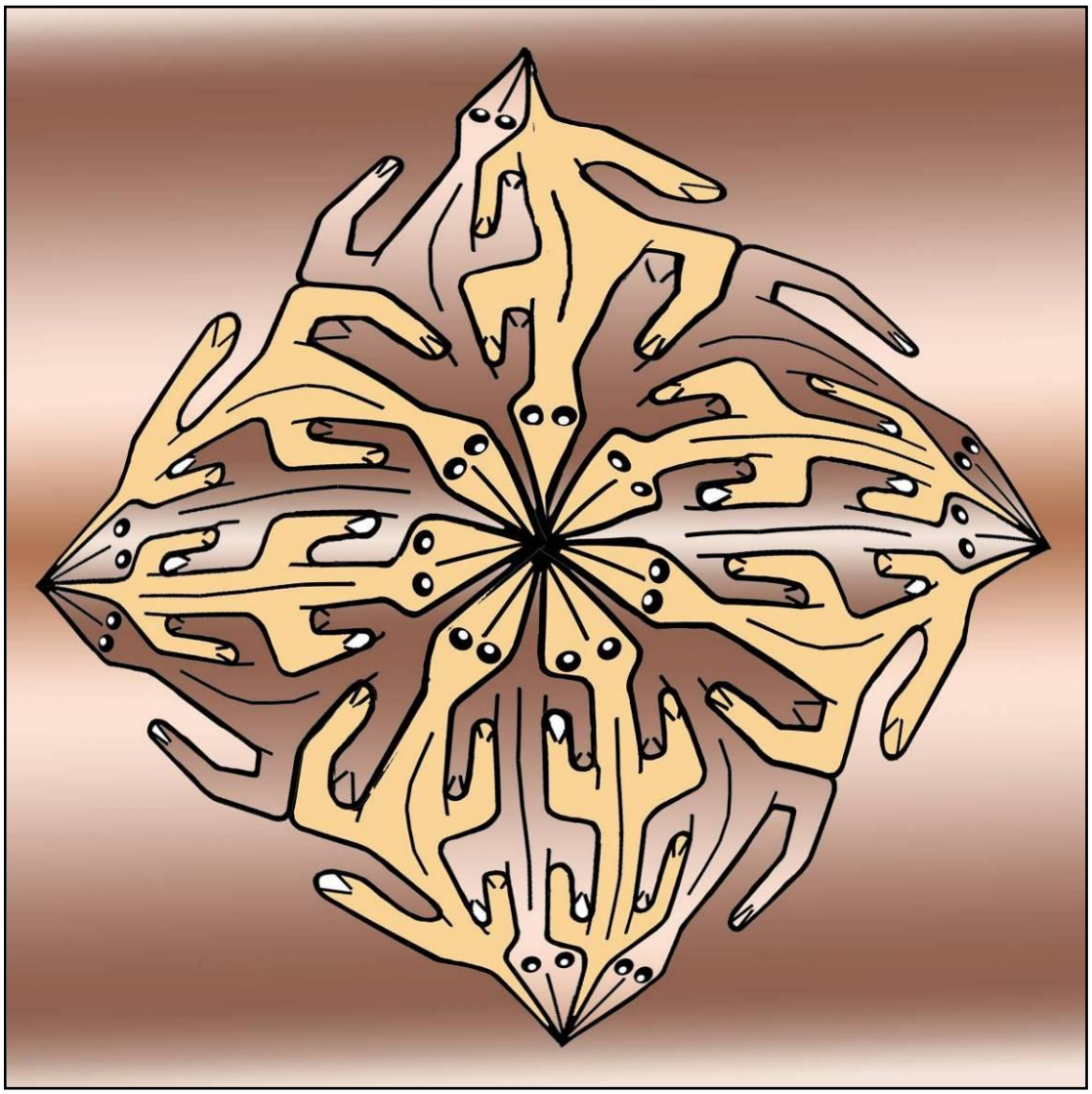


Pour les oies et les lézards, nous avons un élément de plus dans les pavages de droite.

PHOTOGRAPHIES

DIAPORAMA

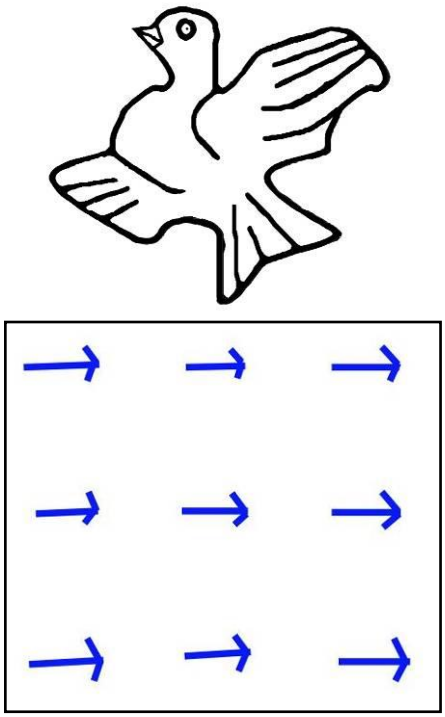


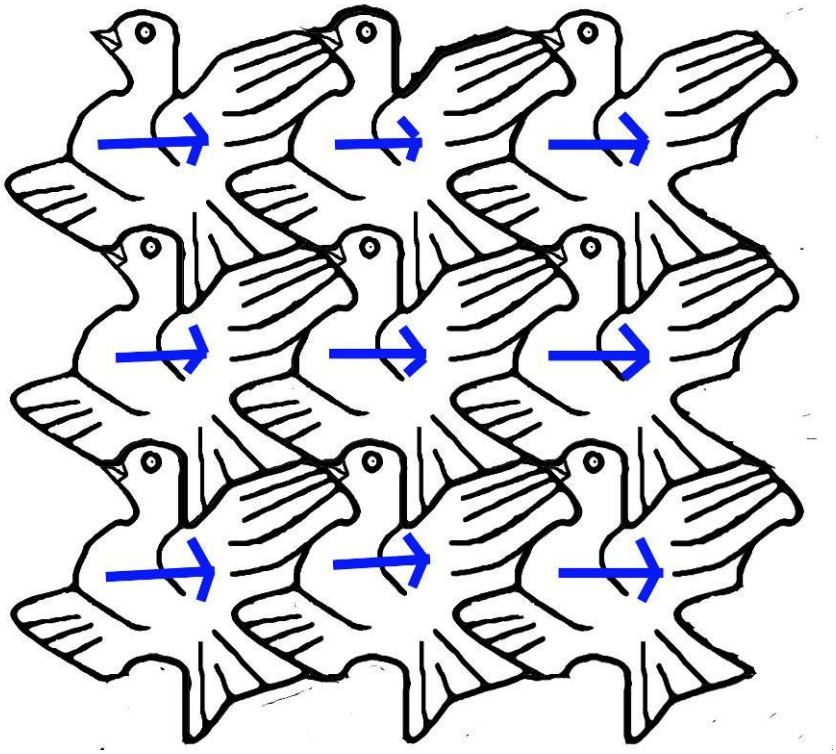


En haut, huit lézards tête au centre, en bas sept lézards tête au centre.

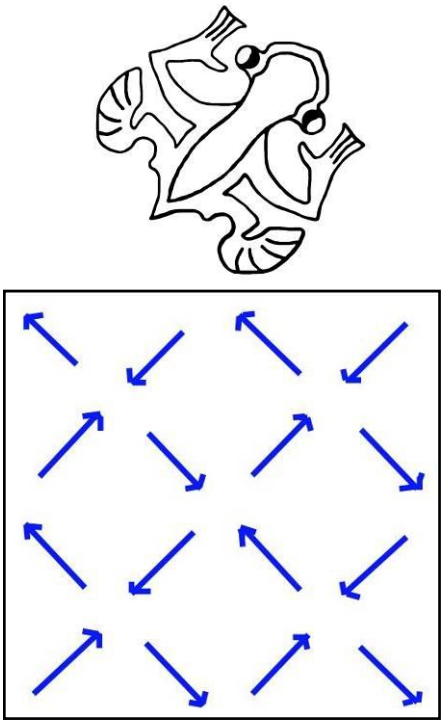
IV. Association de pavés :

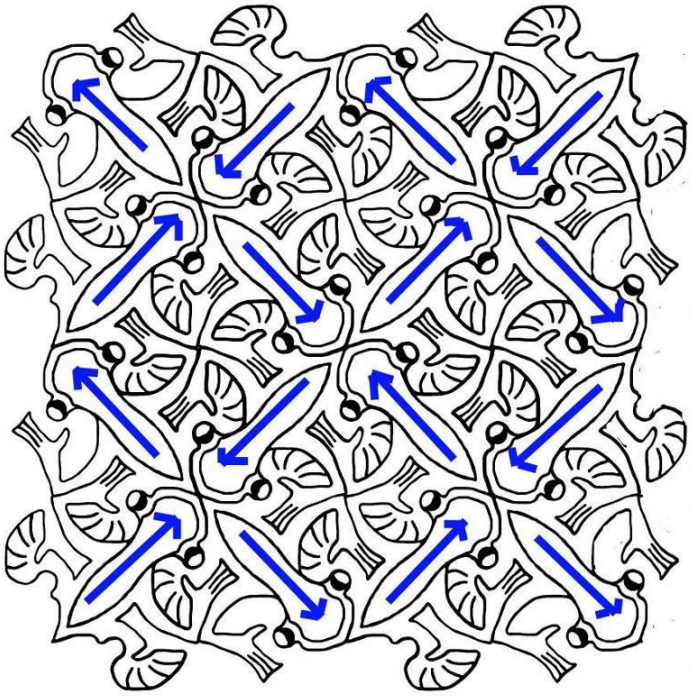
Selon le type de polygone et les isométries utilisées, les pavés s'emboîtent avec des orientations différentes ; en voici quelques exemples :





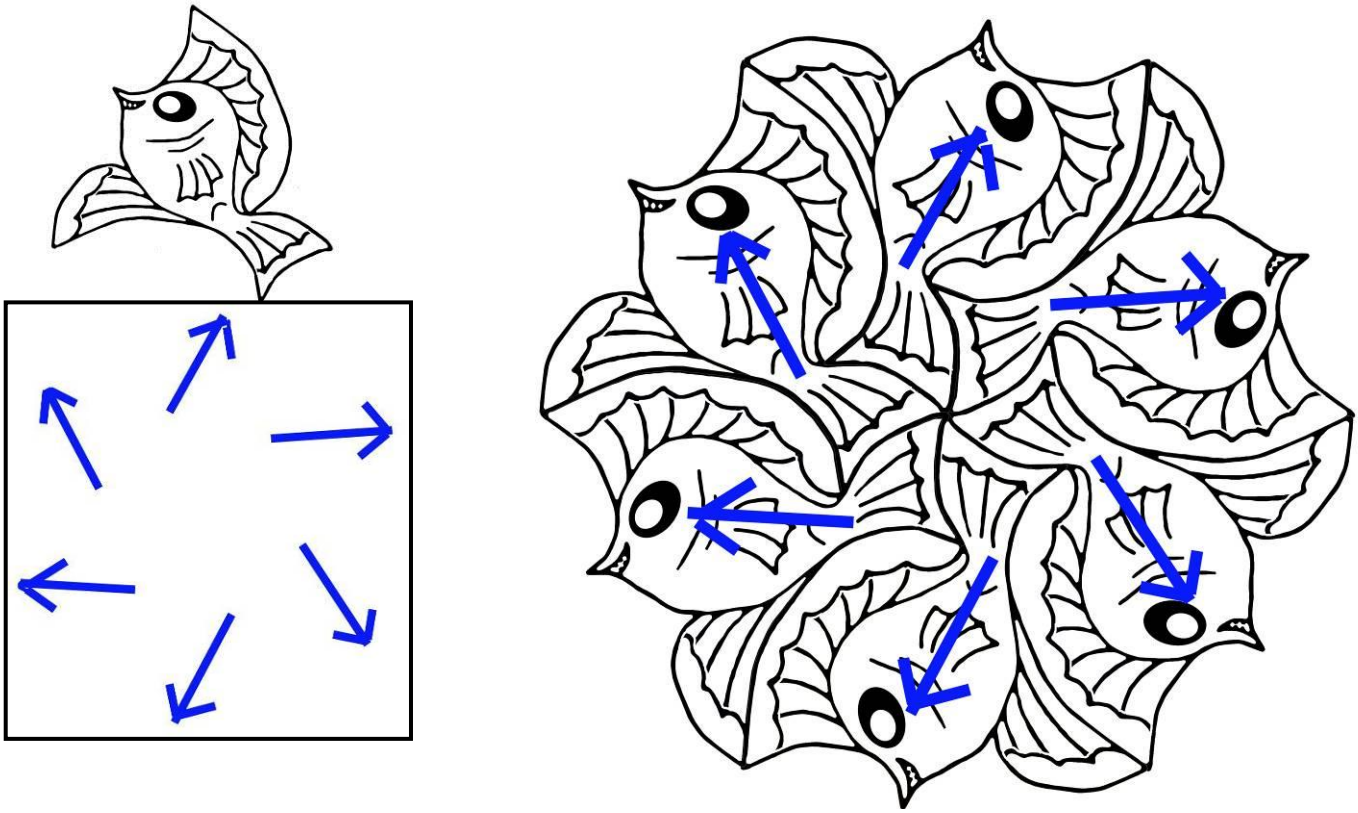
Une direction : le polygone est un carré ; une translation utilisée.



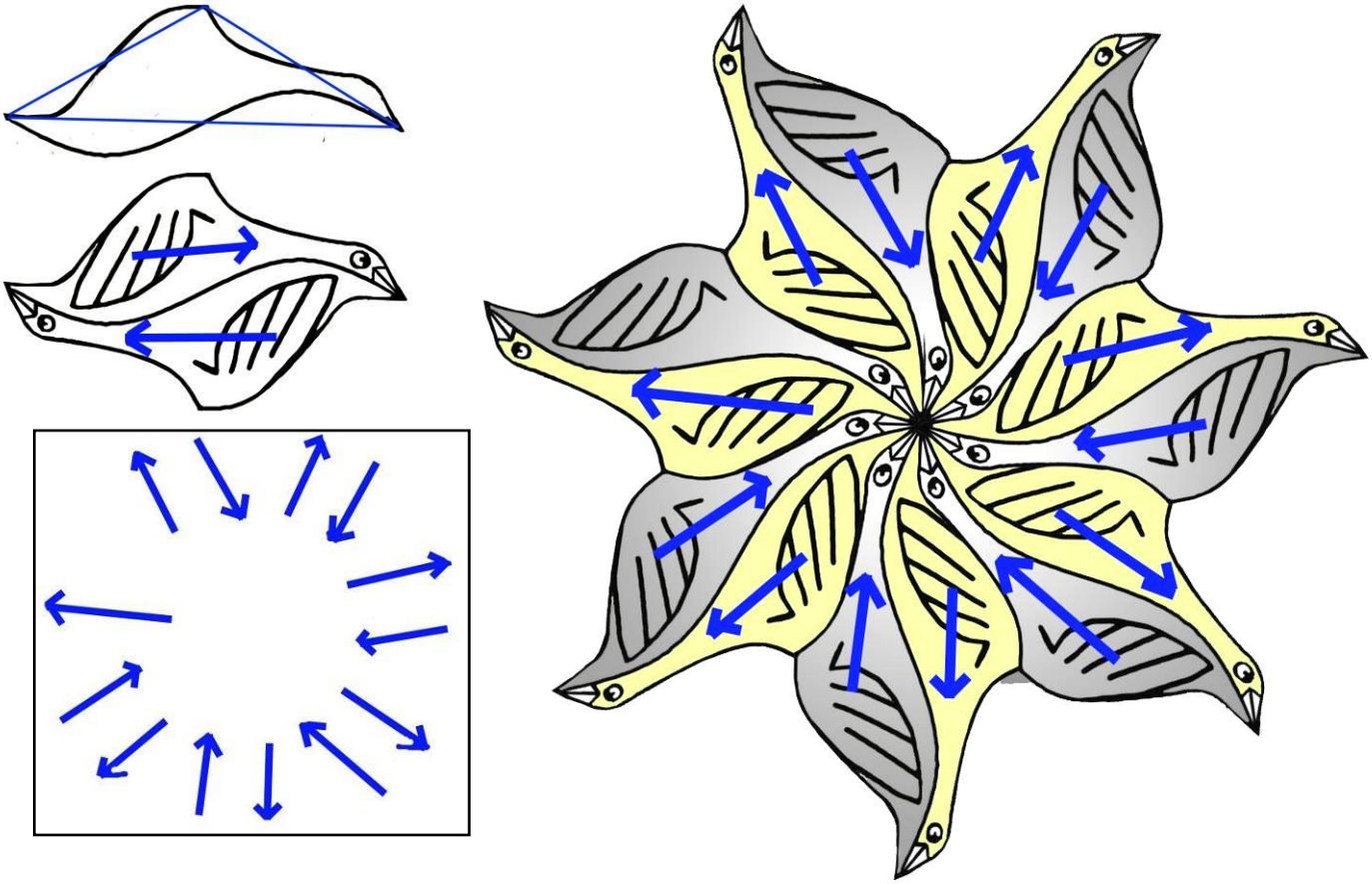


Quatre directions : le polygone est un carré ; une rotation et deux réflexions glissées.

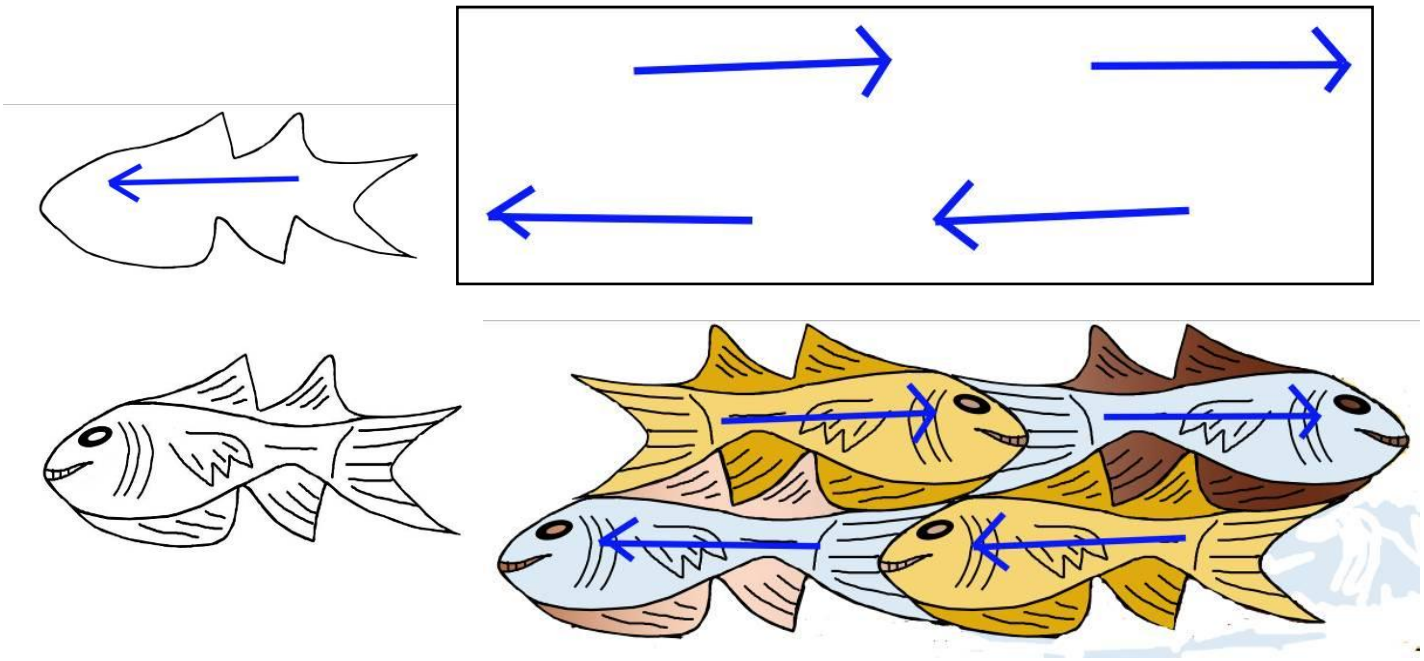
RETOUR



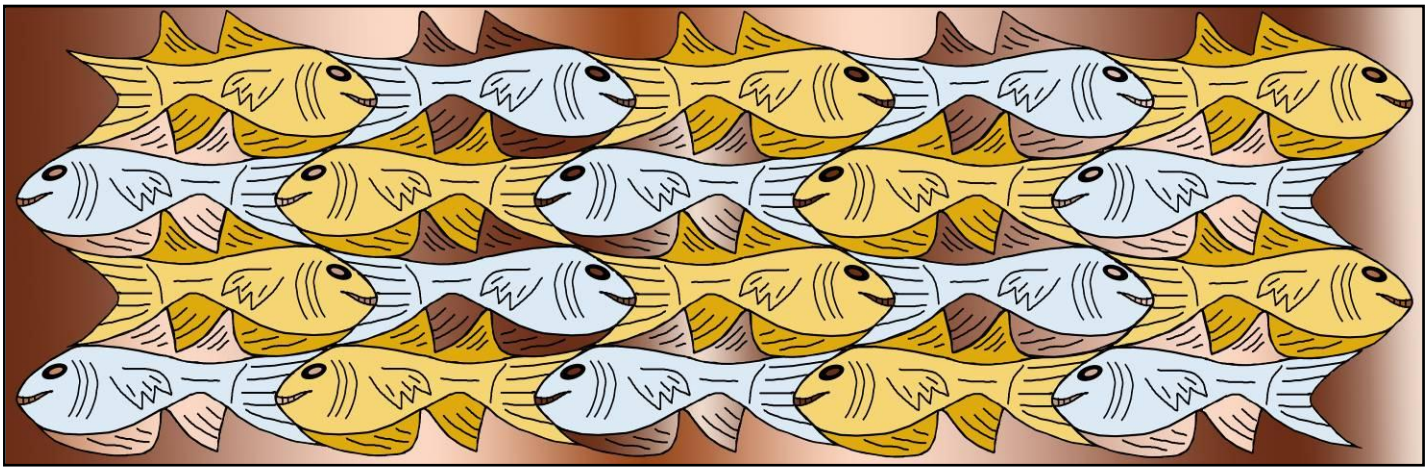
Six directions : une triangle équilatéral ; deux rotations et une symétrie centrale.



Douze directions : un triangle isocèle ; deux symétries axiales et une rotation.



Deux directions : le pavé est un rectangle ; deux translations et une symétrie.



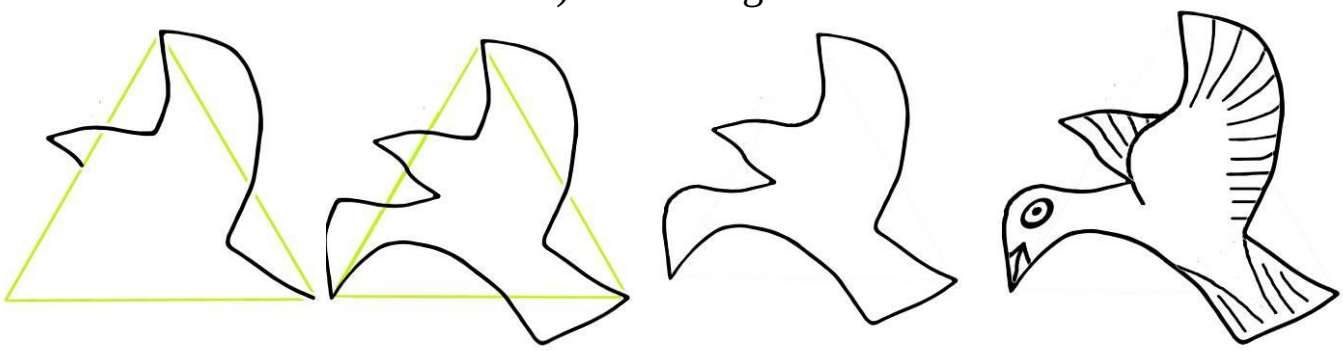
Remarques :

Il arrive qu'un pavage soigneusement préparé ne marche pas. En effet, il existe des relations étroites entre les polygones et les isométries, les mathématiciens ont démontré qu'il n'y a que 17 manières d'agencer les polygones et les isométries pour paver le plan. A vous de trouver les bonnes. Cependant, si on reste sur des polygones simples, ça marche presque à tous les coups.

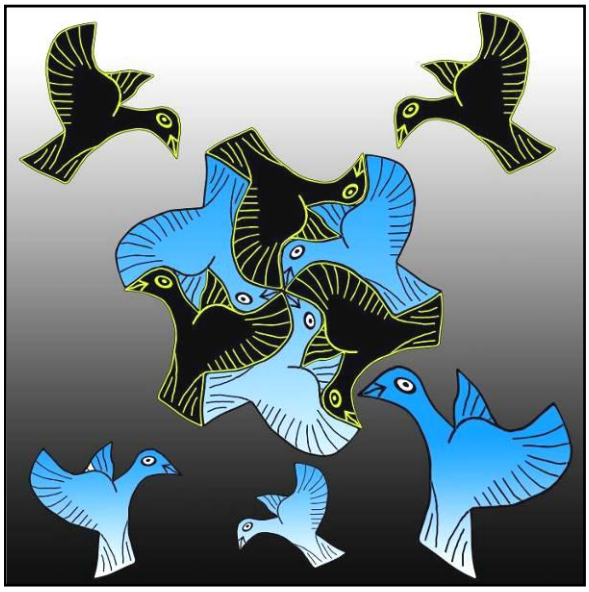
Pour ce qui est des transformations polaires, le logiciel PHOTOSHOP possède un filtre **transformation polaire** qui s'occupera de vos problèmes à condition que la finesse de votre travail n'excède pas 3000 / 3000 pixels. Toutes les illustrations et pavages de ce petit livre ont étés conçus avec ce logiciel. L'écriture et la mise en page sur WORD 2003

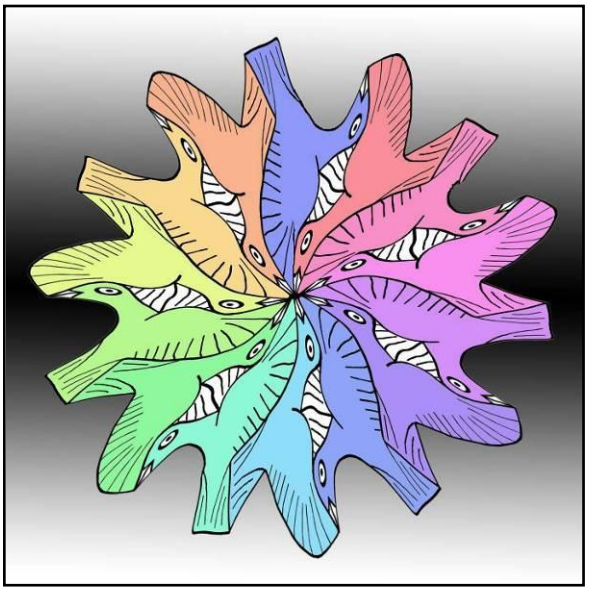
V. Exemples : CONSTRUCTION

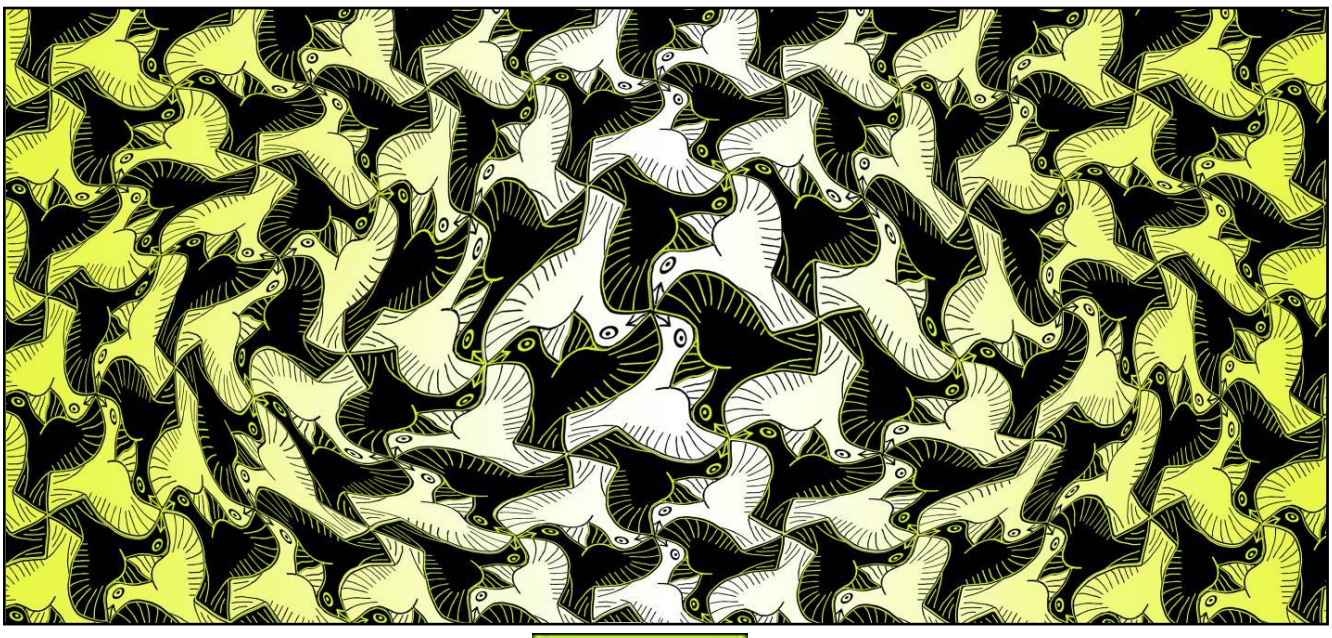
a) Les triangles :



Triangle équilatéral ; une symétrie centrale et une rotation de 60°.

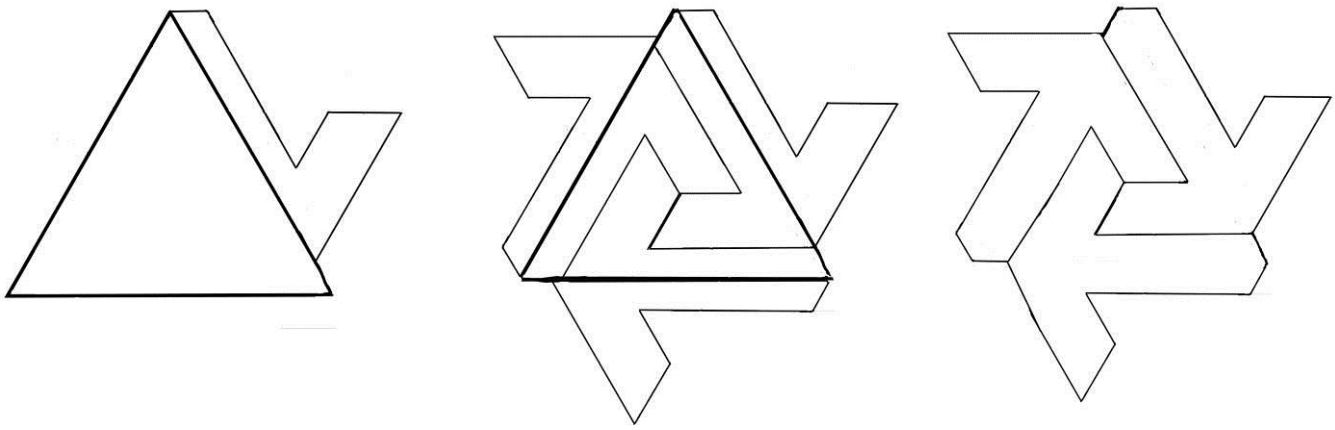




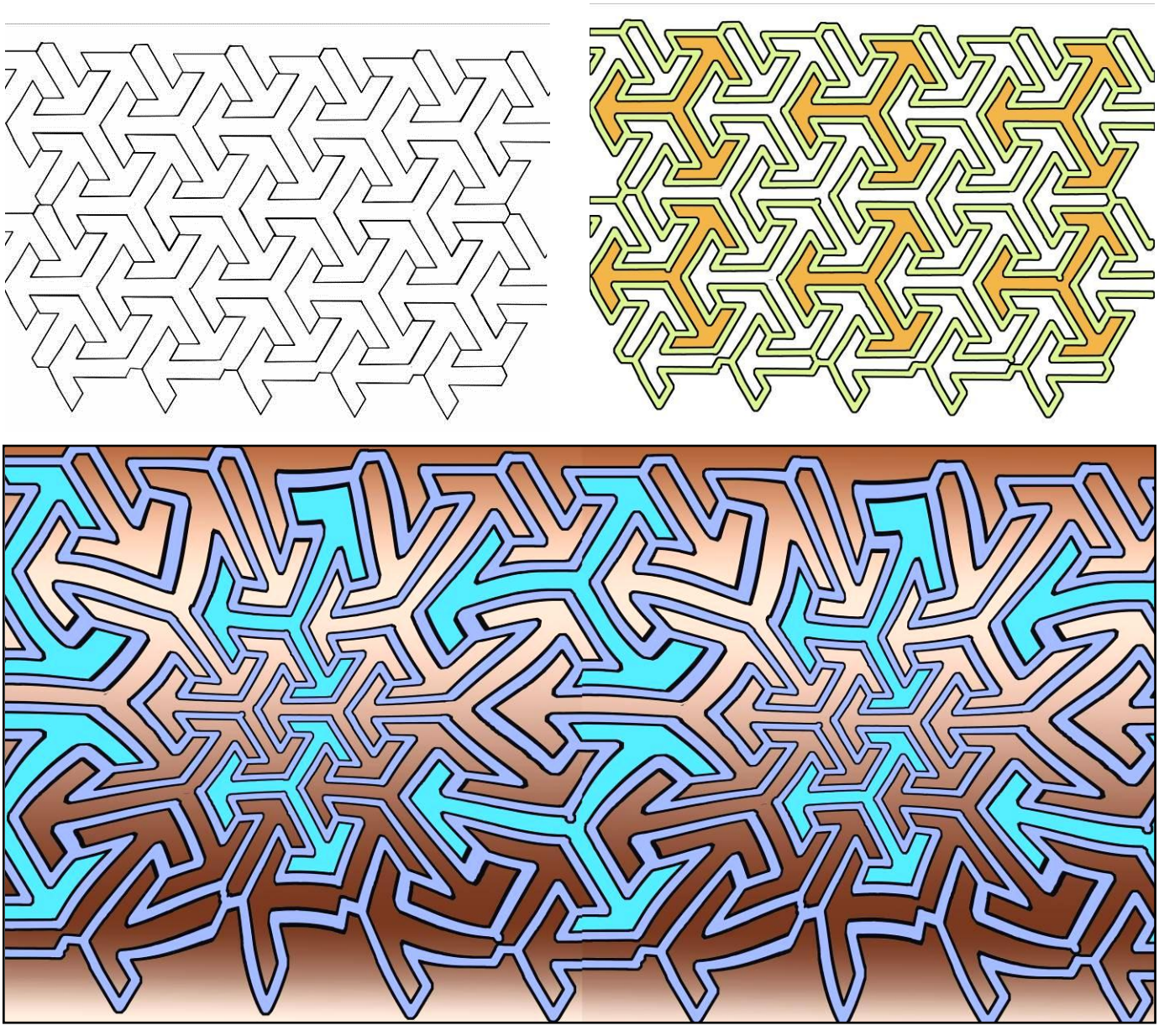


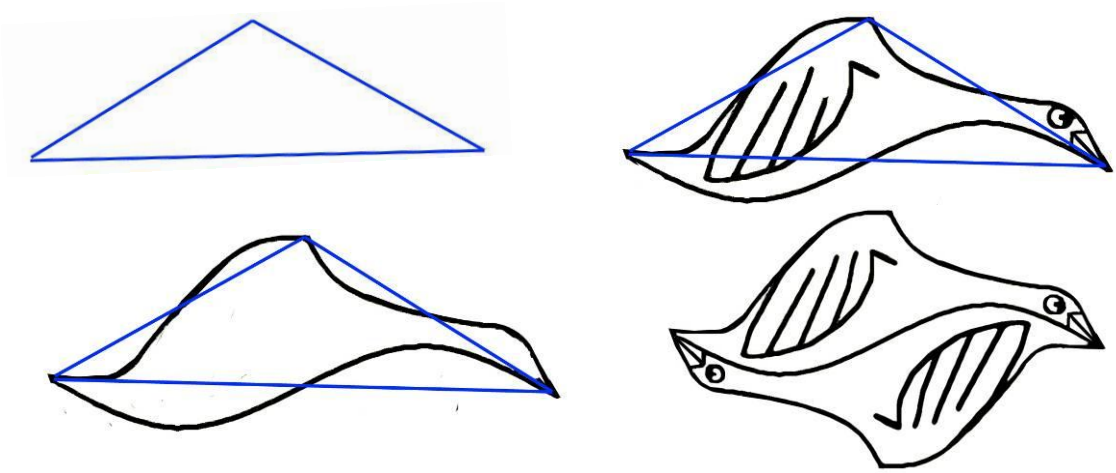
RETOUR

Alhambra de Grenade :

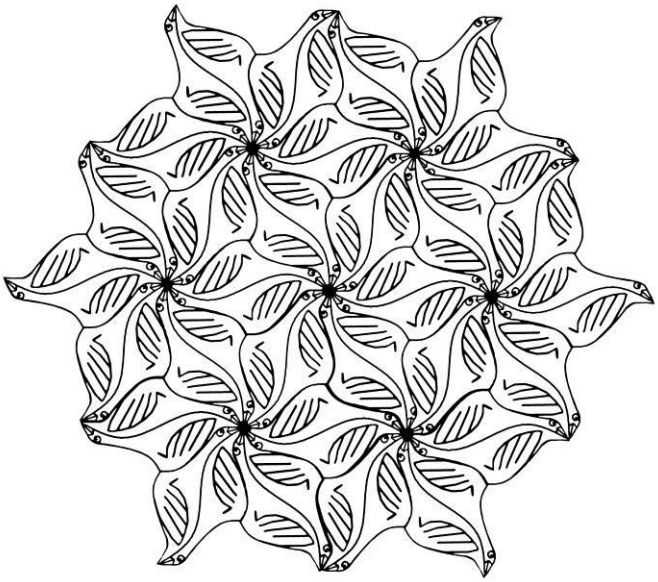


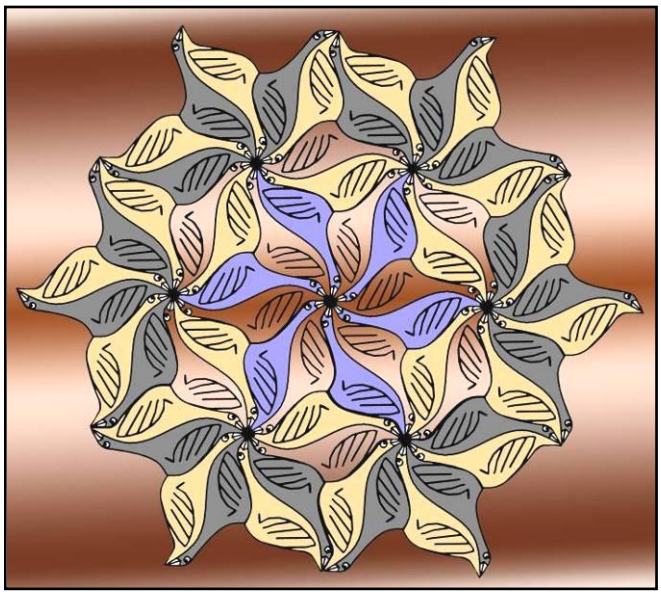
Triangle équilatéral : réflexions glissées.

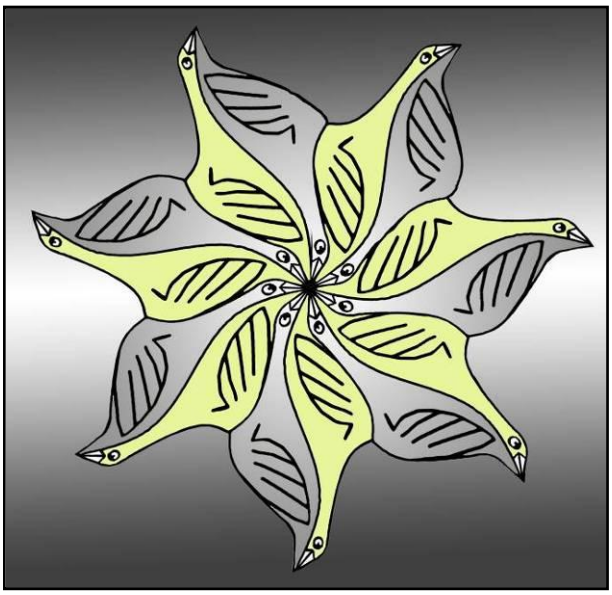




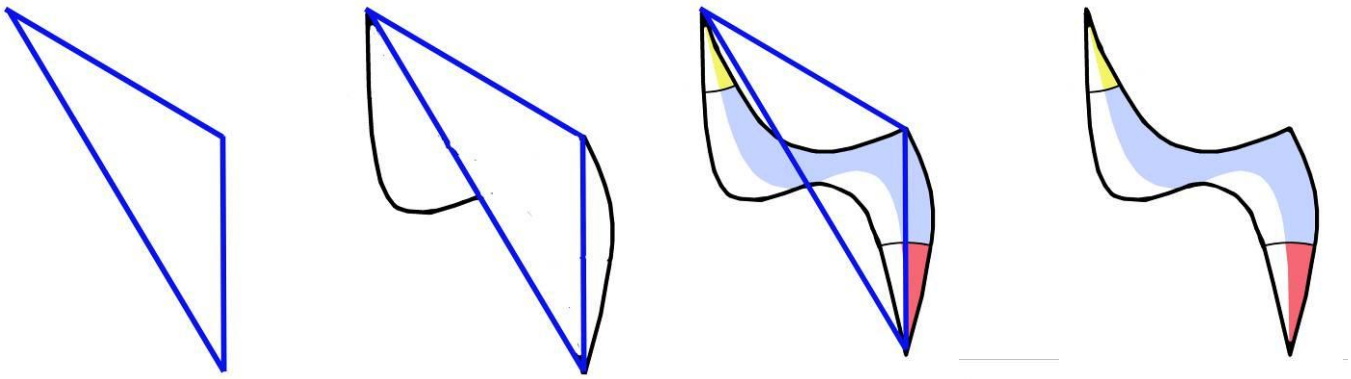
Triangle isocèle avec les deux angles à la base de 30° : symétrie axiale et réflexion glissée.

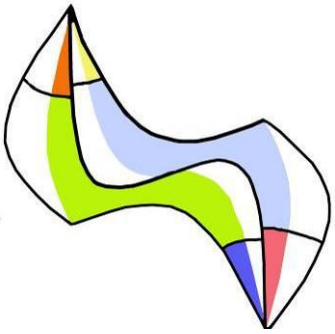






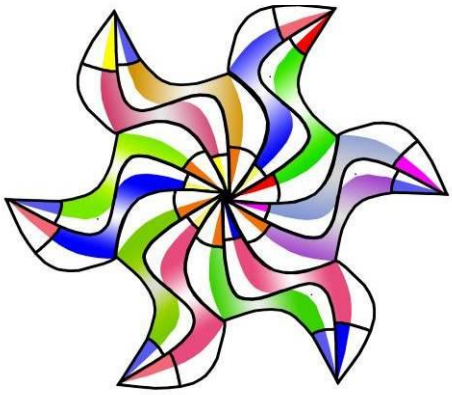
À gauche, 12 directions et à droite, 14 direction car il y a 7 têtes au centre.

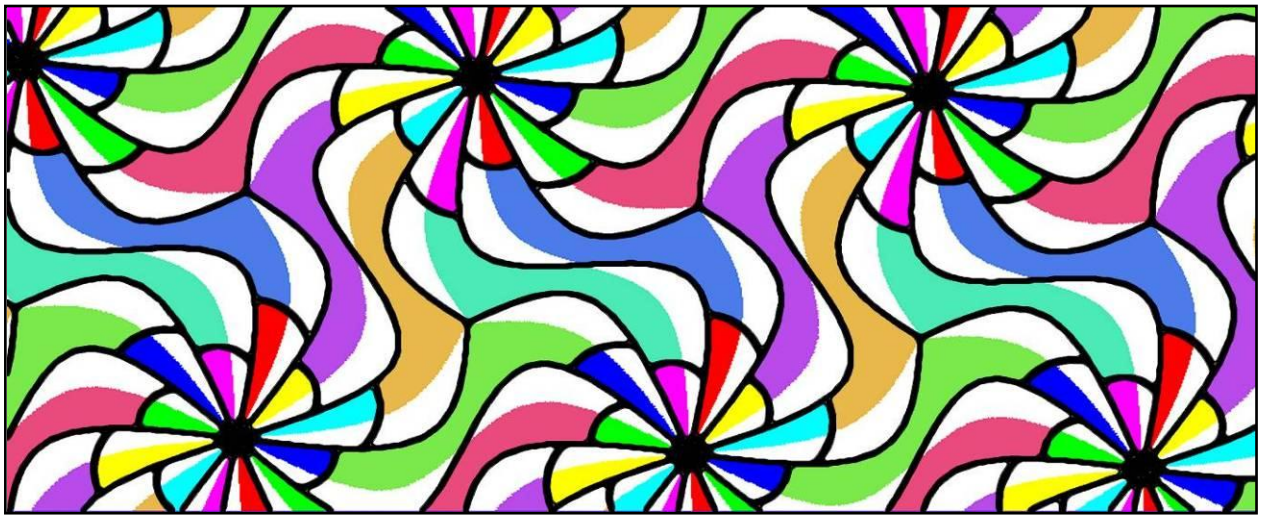


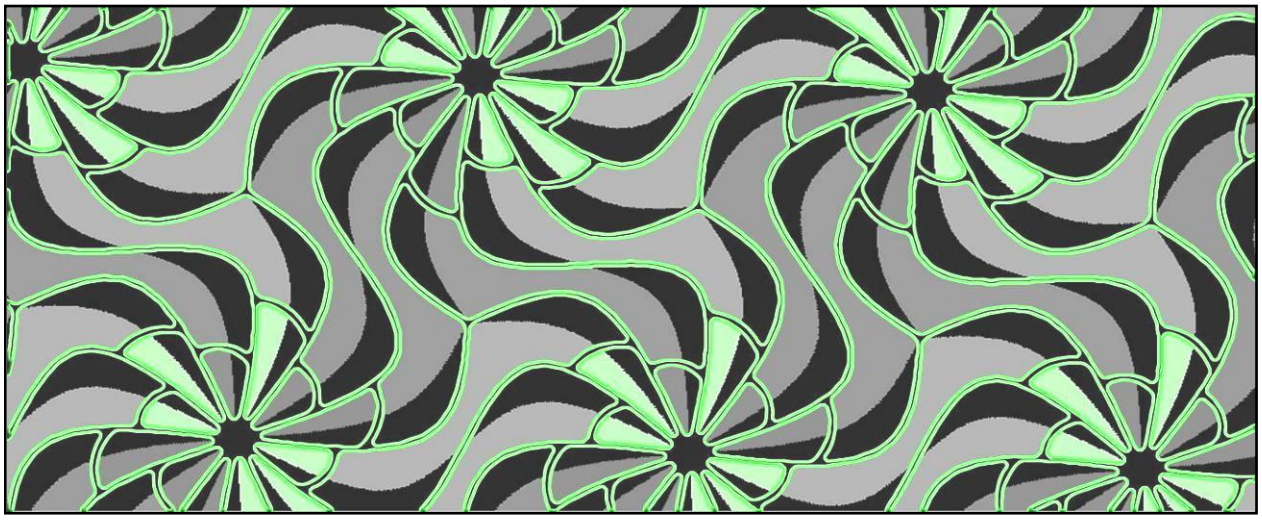


CONSTRUCTION

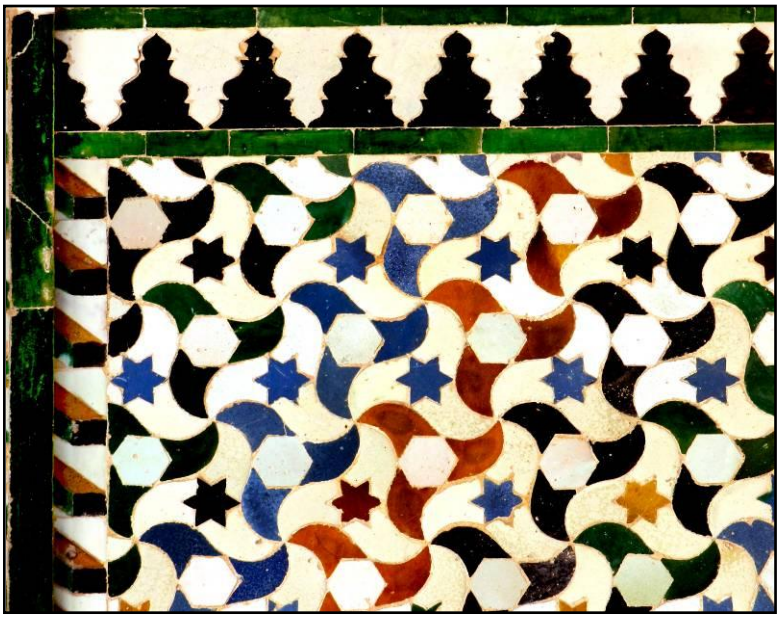
Triangle isocèle avec deux angles à la base de 30°.
Deux rotations à 30°.

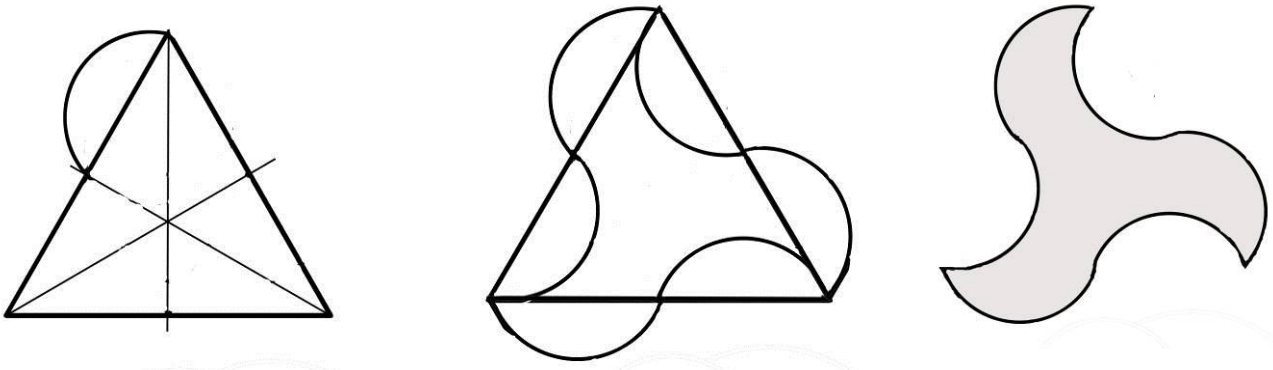




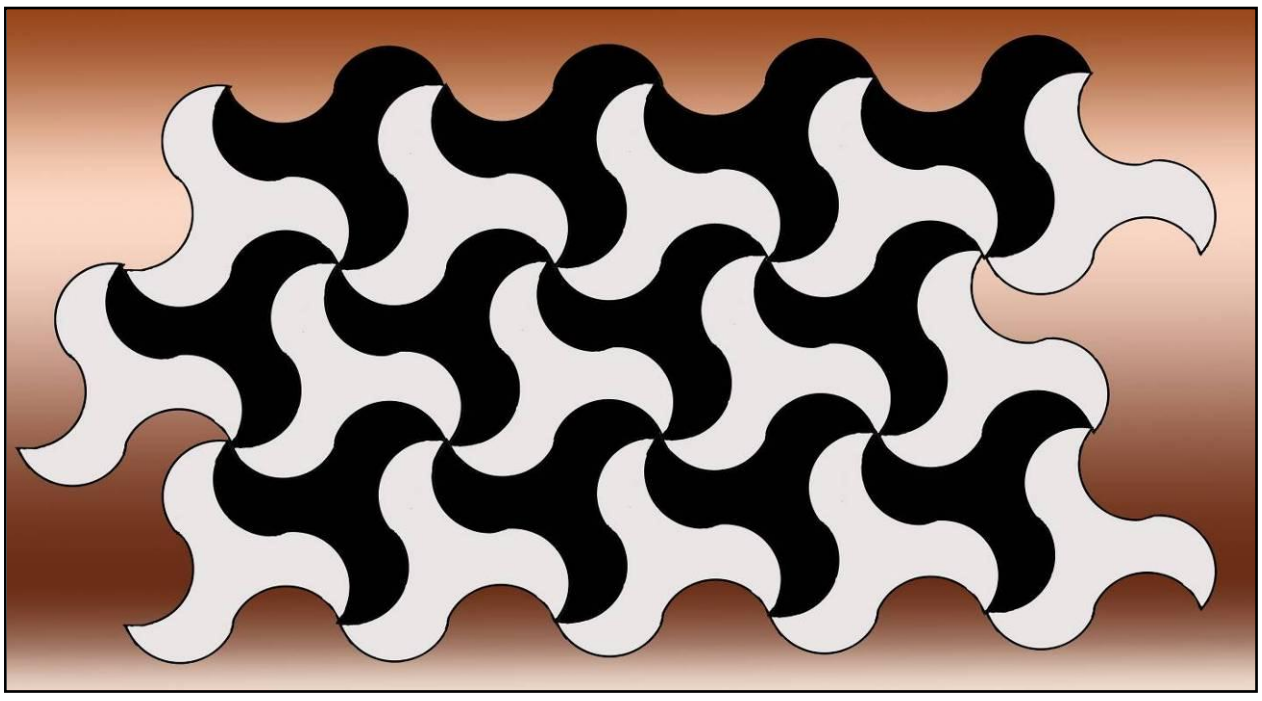


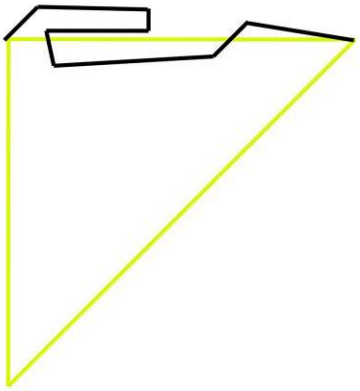
Alhambra de Grenade

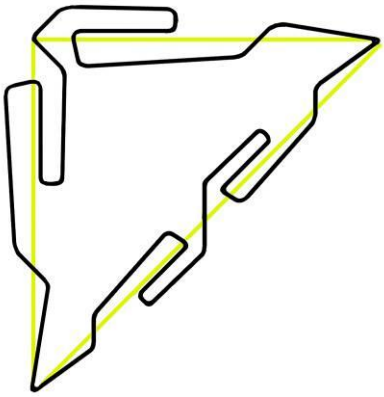


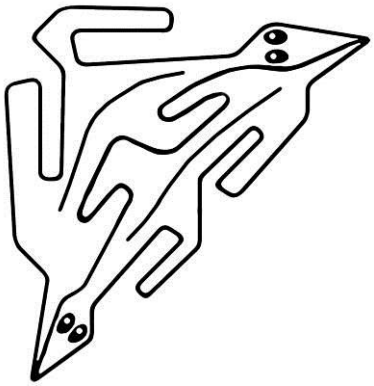


Triangle équilatéral : une symétrie axiale et deux symétries de 60°.



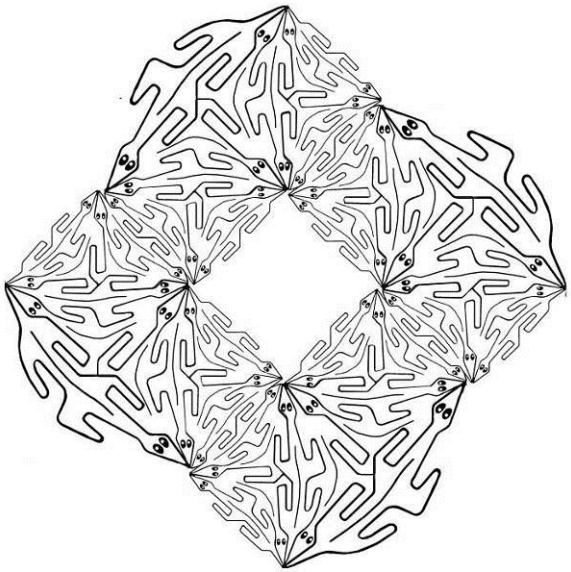


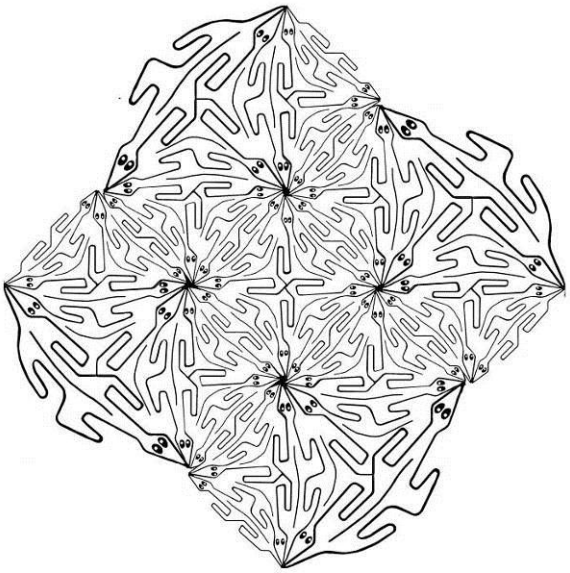


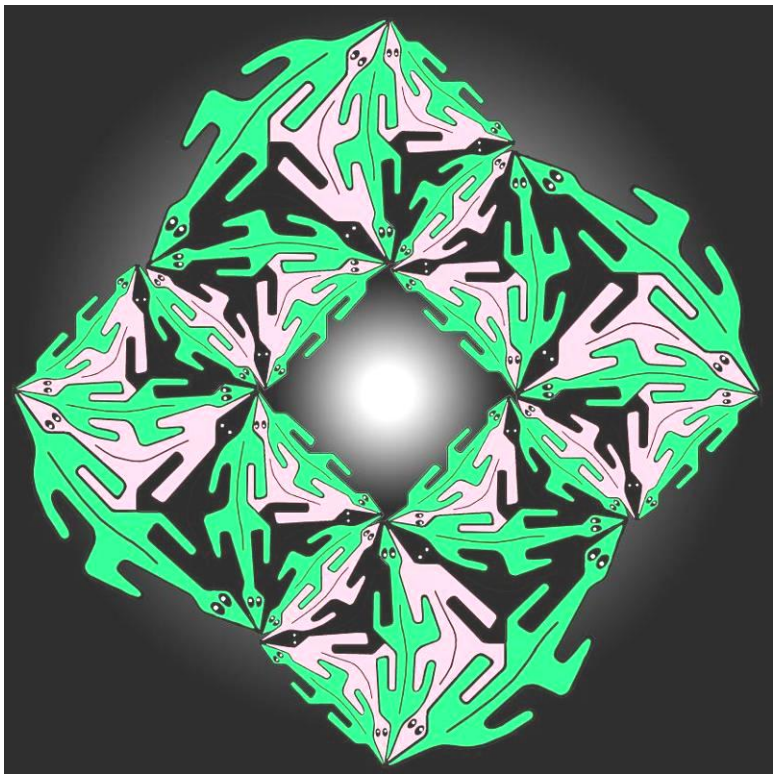


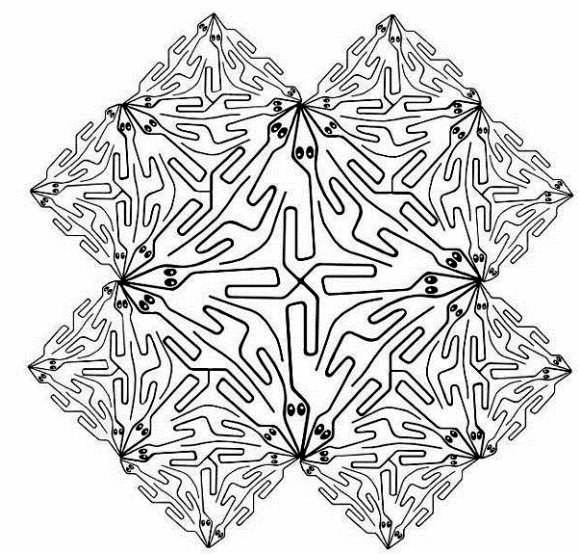
Triangle isocèle rectangle : une rotation de 90°, une rotation de 45° d'une demi hypoténuse suivi d'une symétrie axiale.

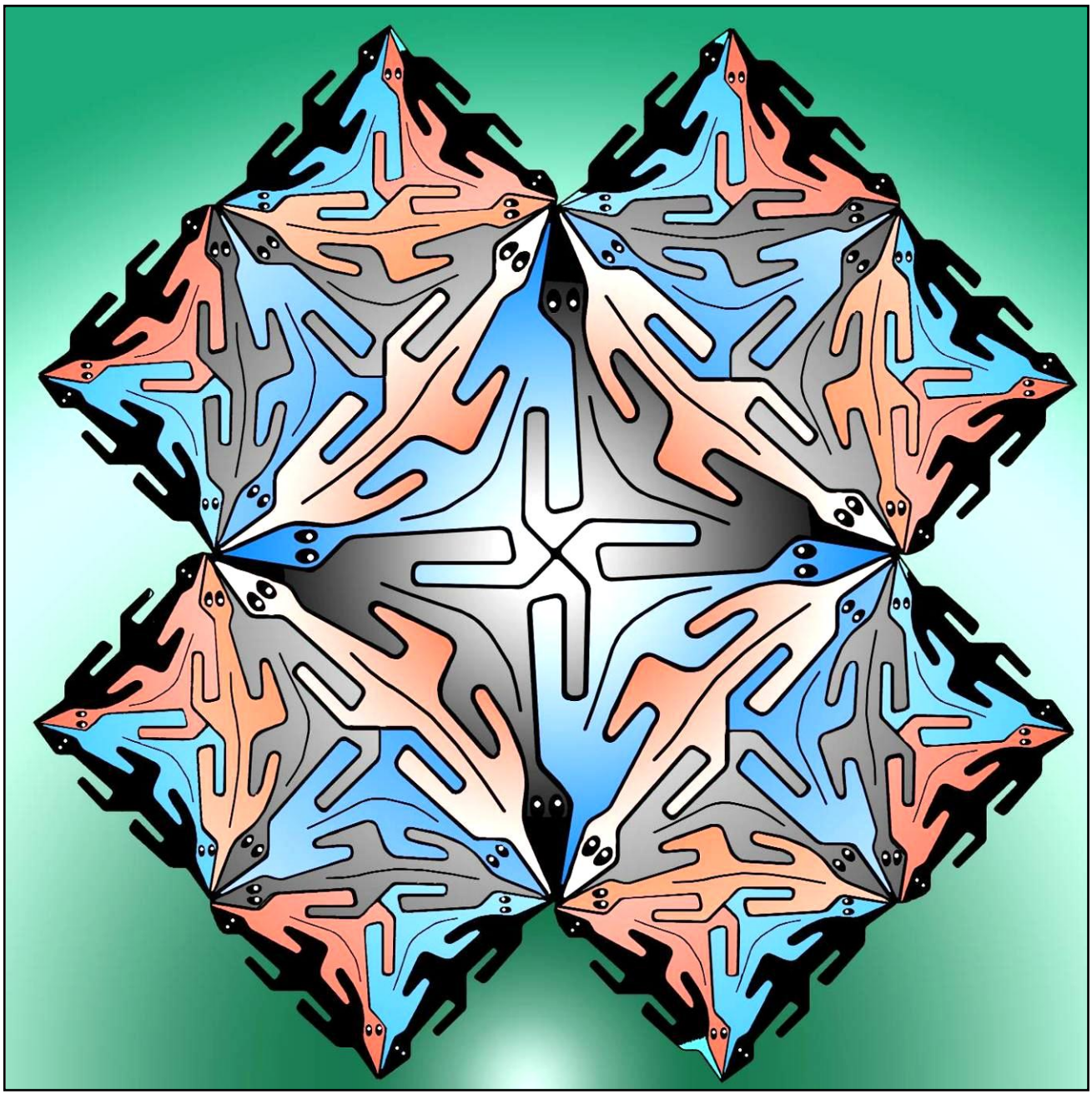
CONSTRUCTION

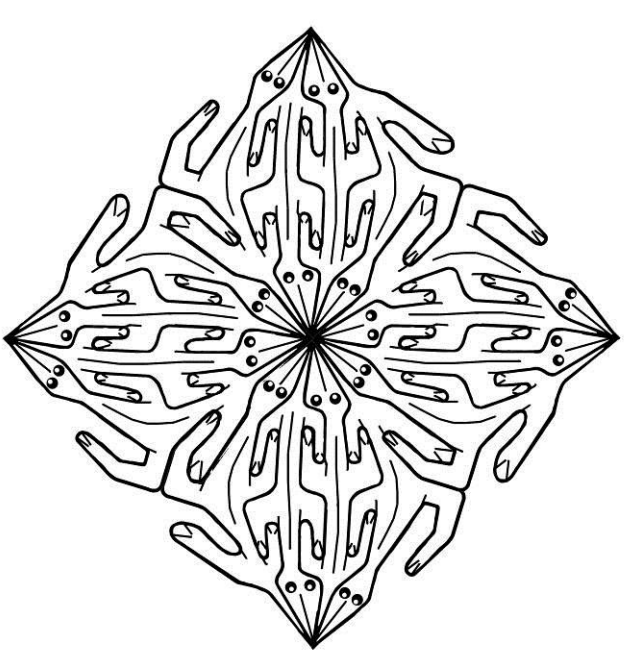


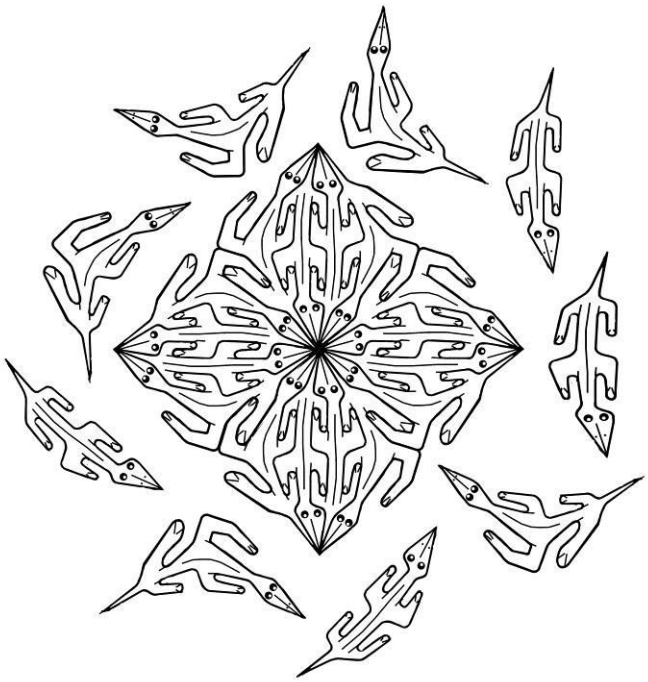


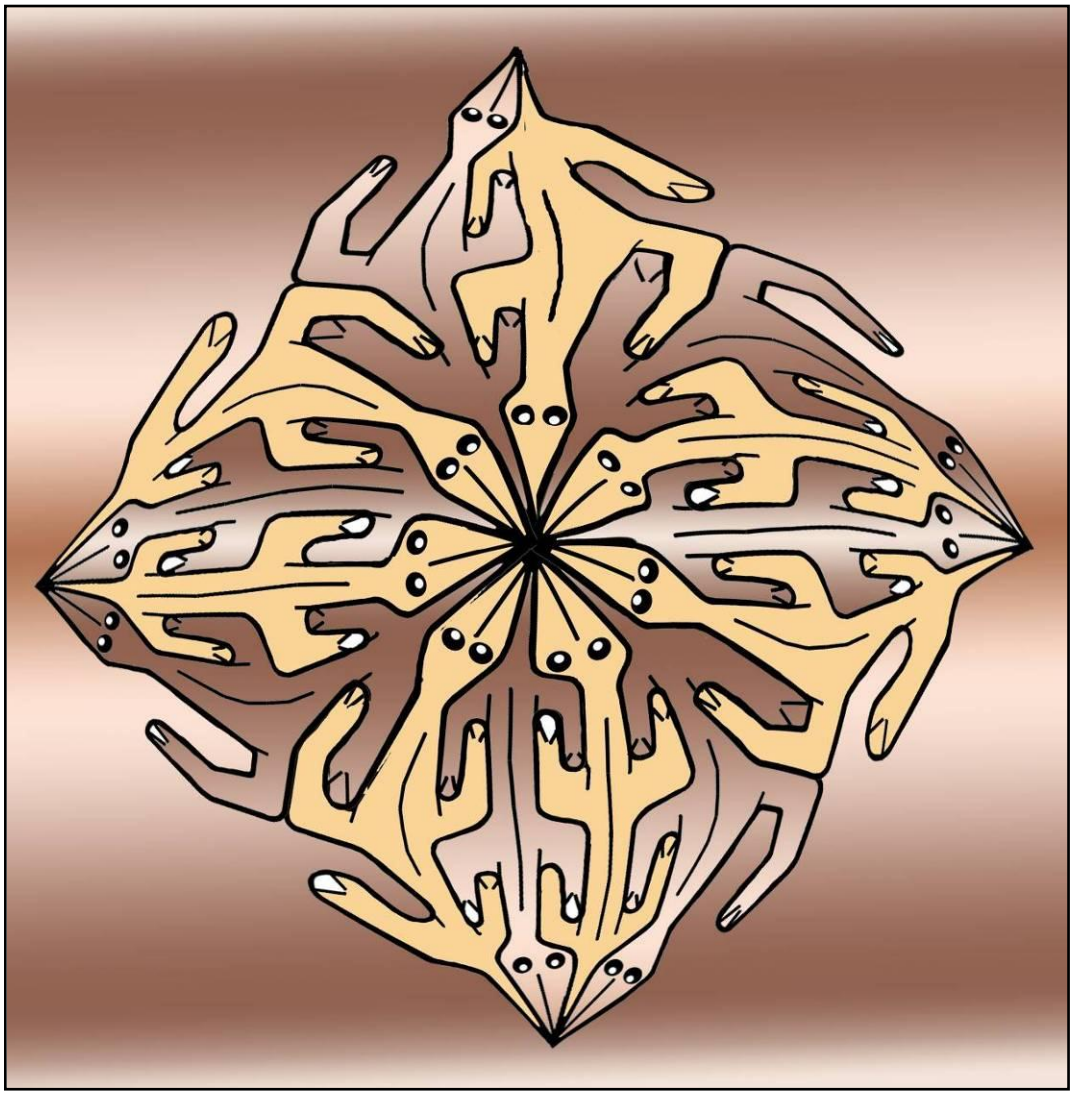




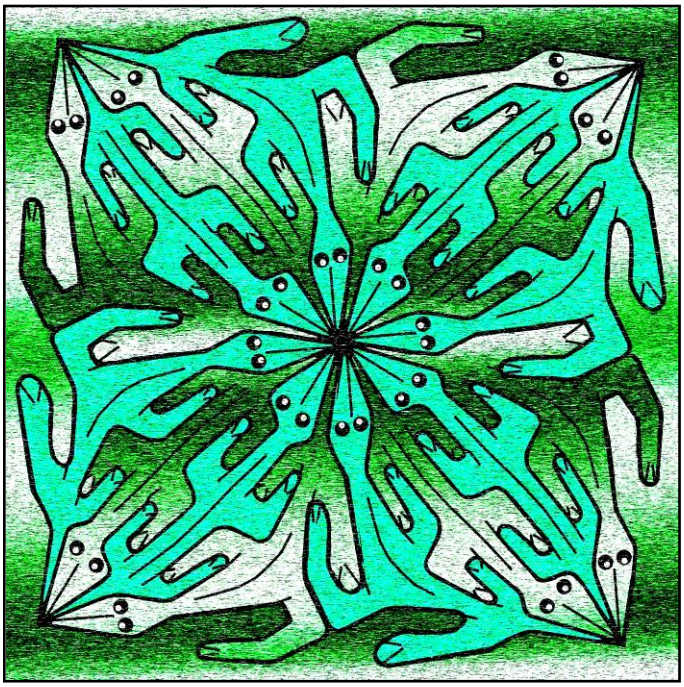


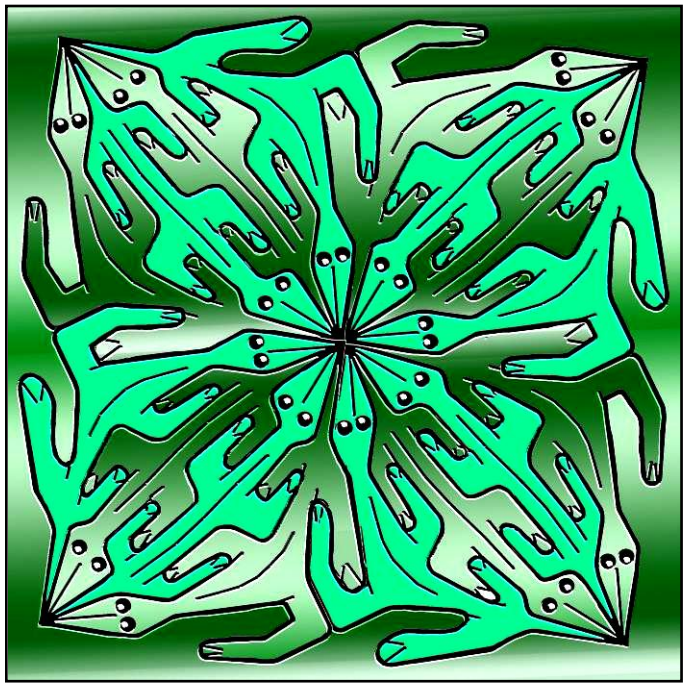


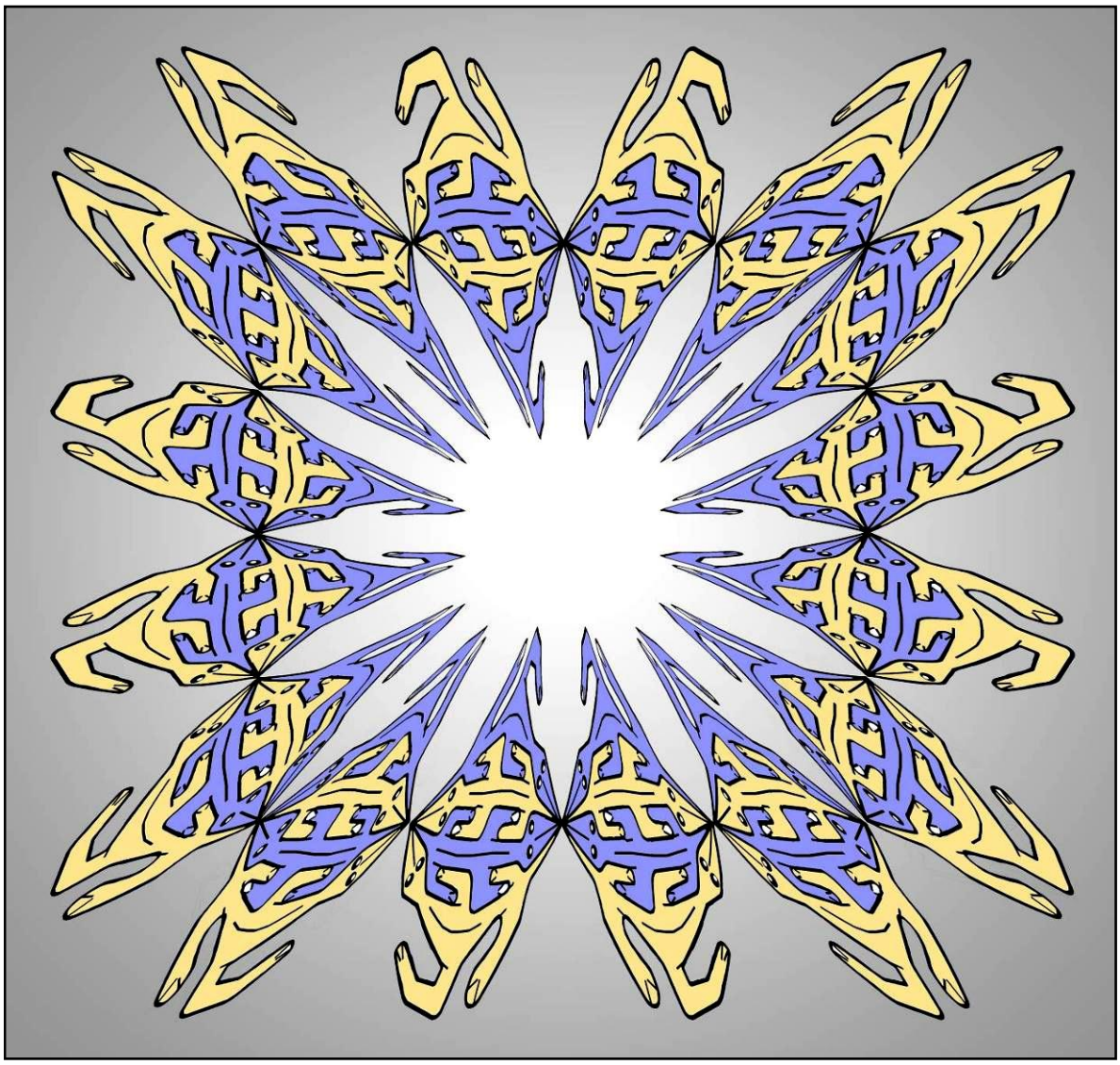


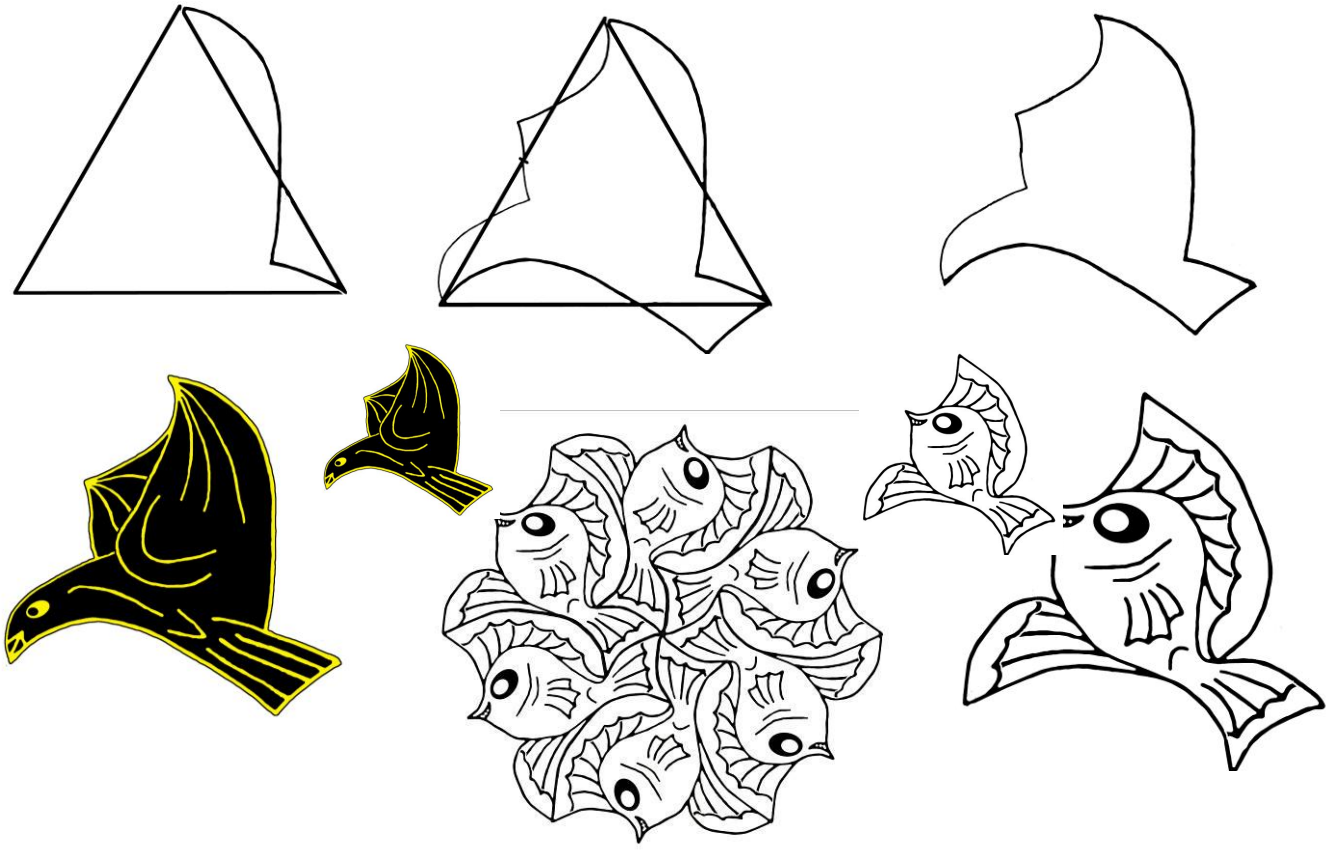


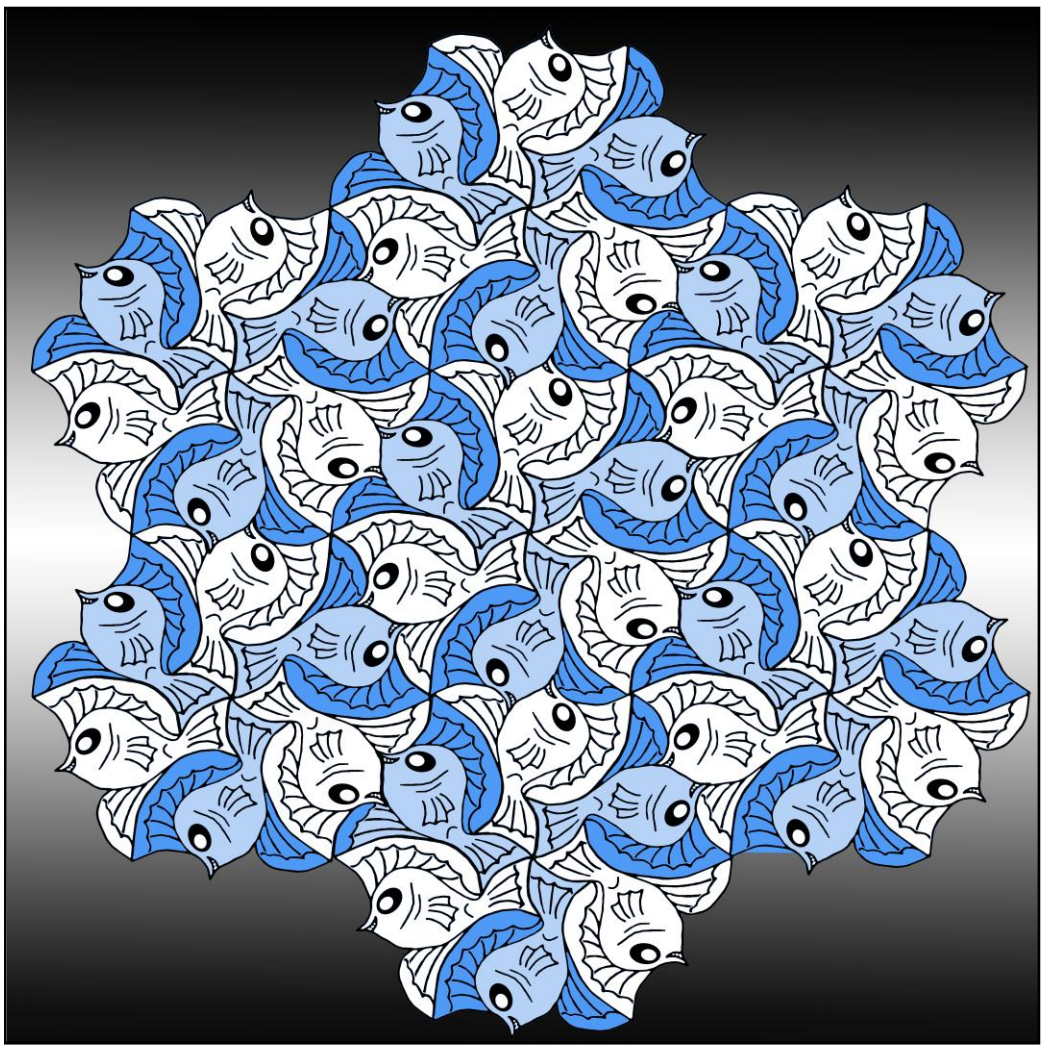
Huit lézards en haut et sept en bas ; utilisation des déformations polaires.

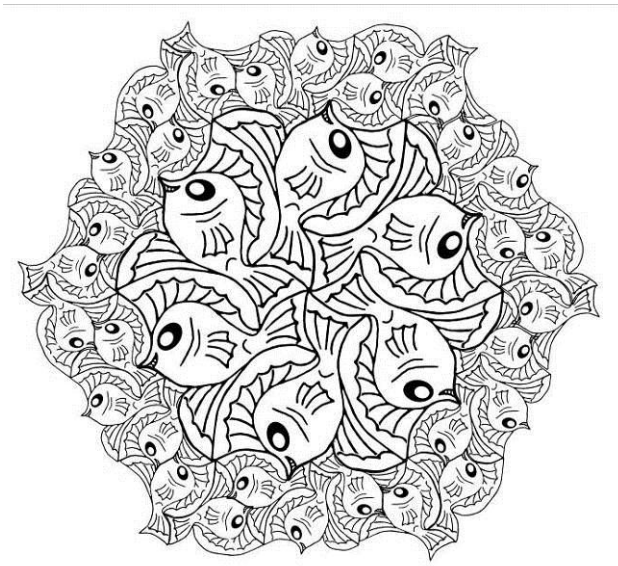


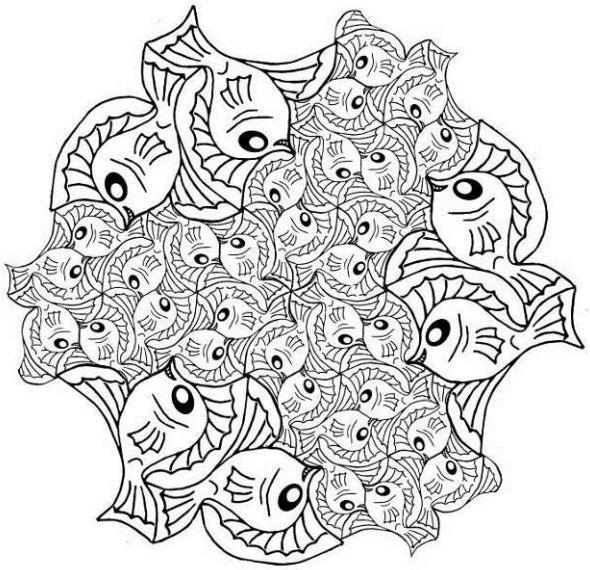


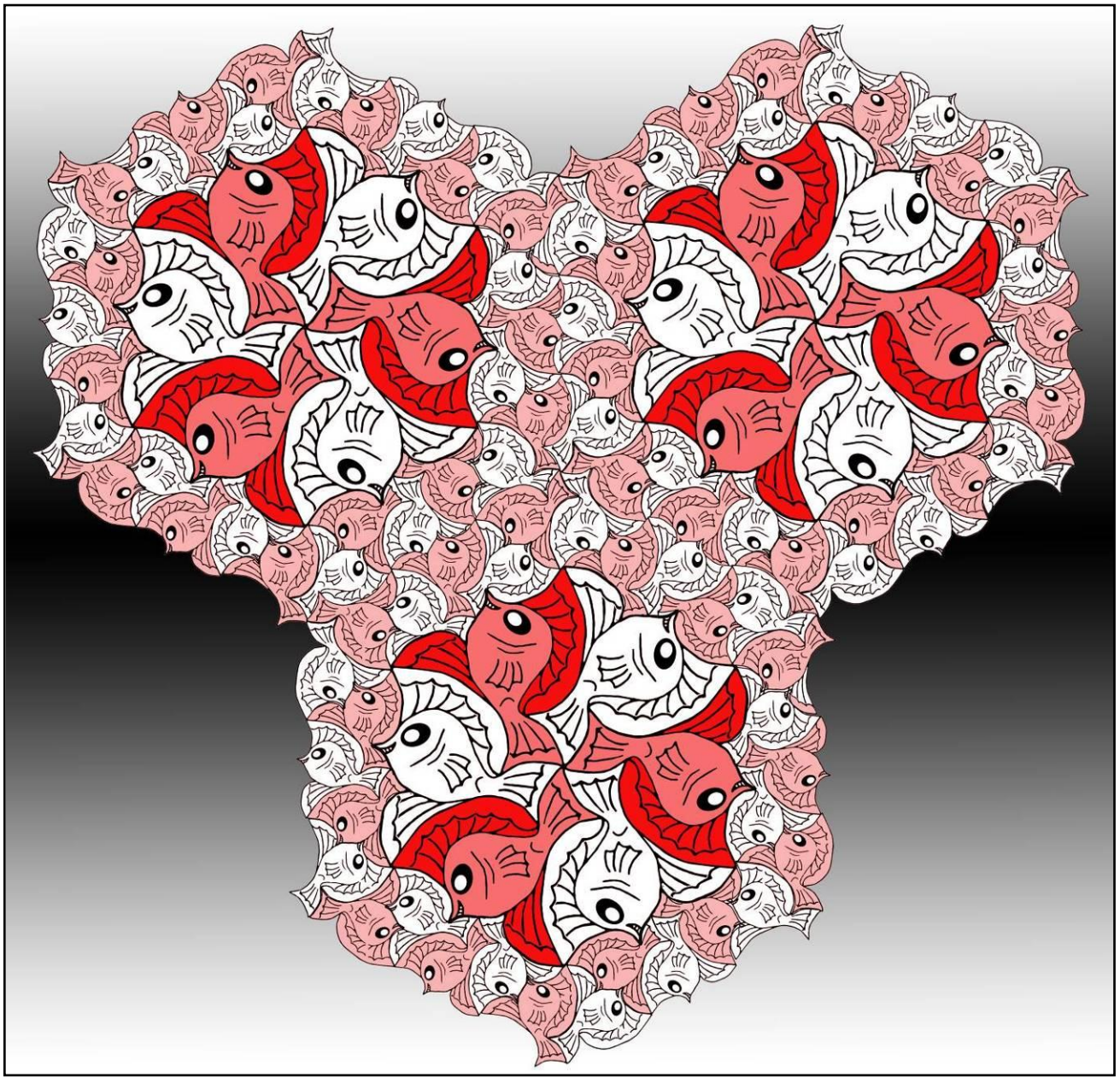


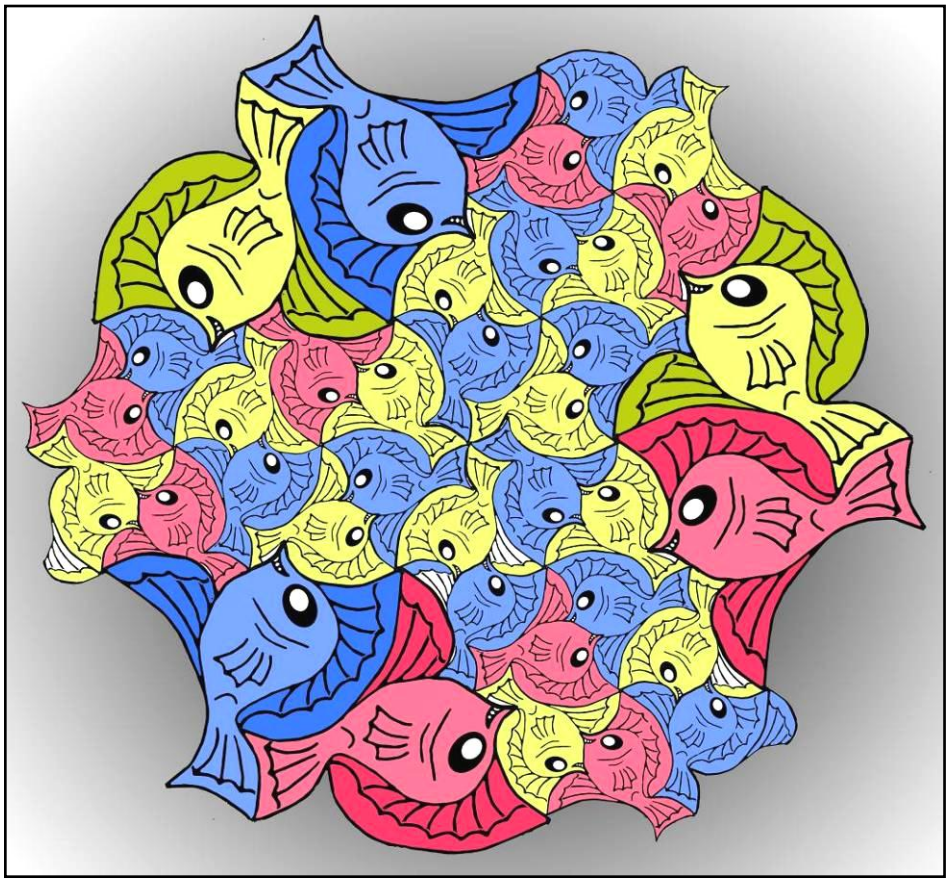


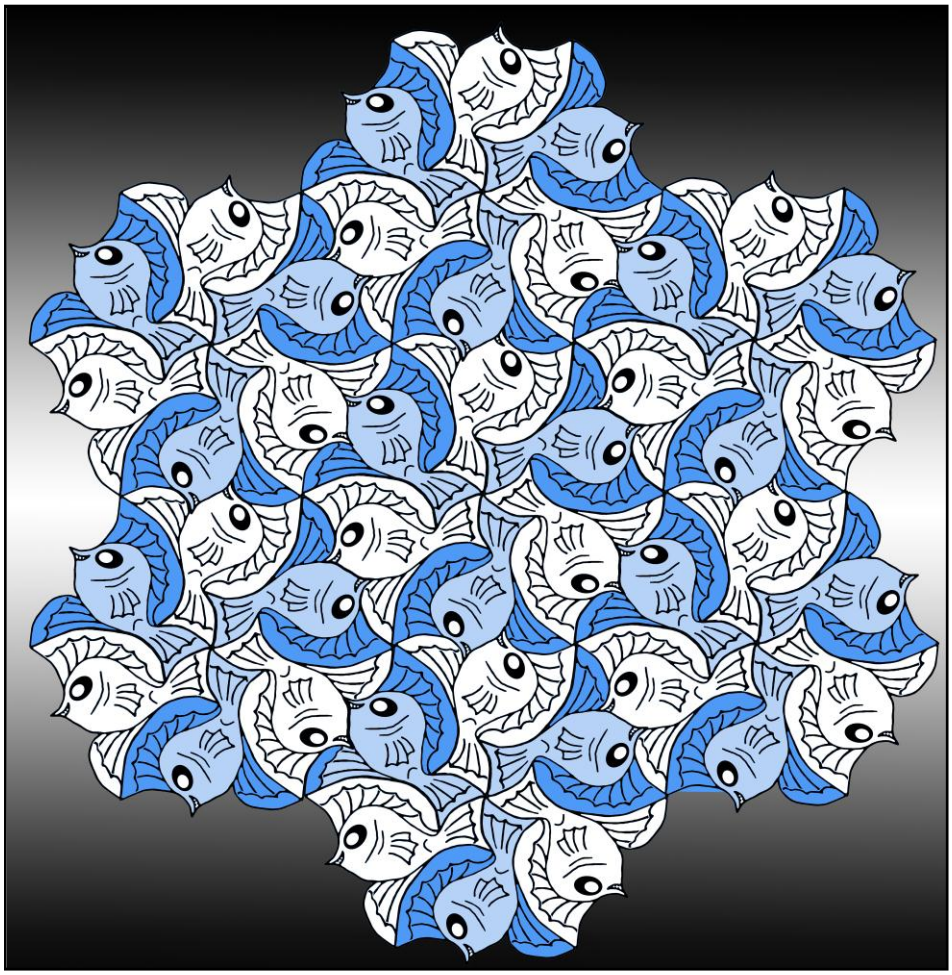


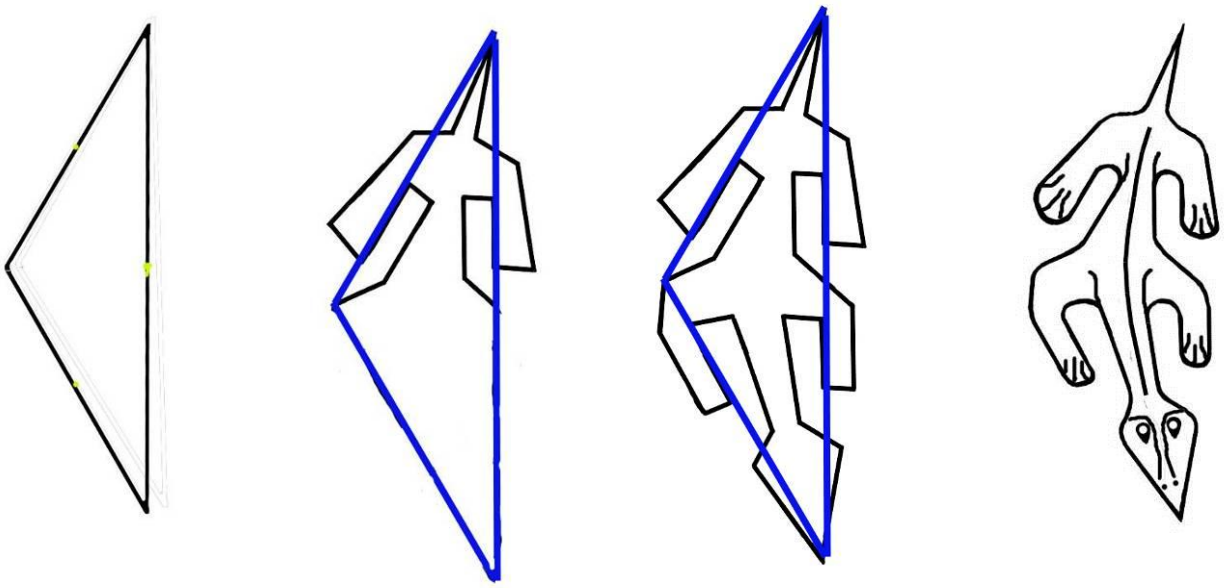




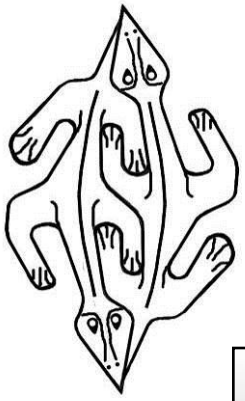






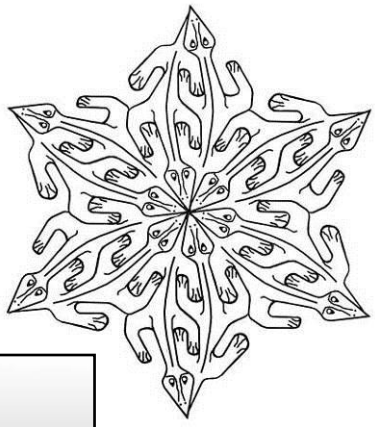


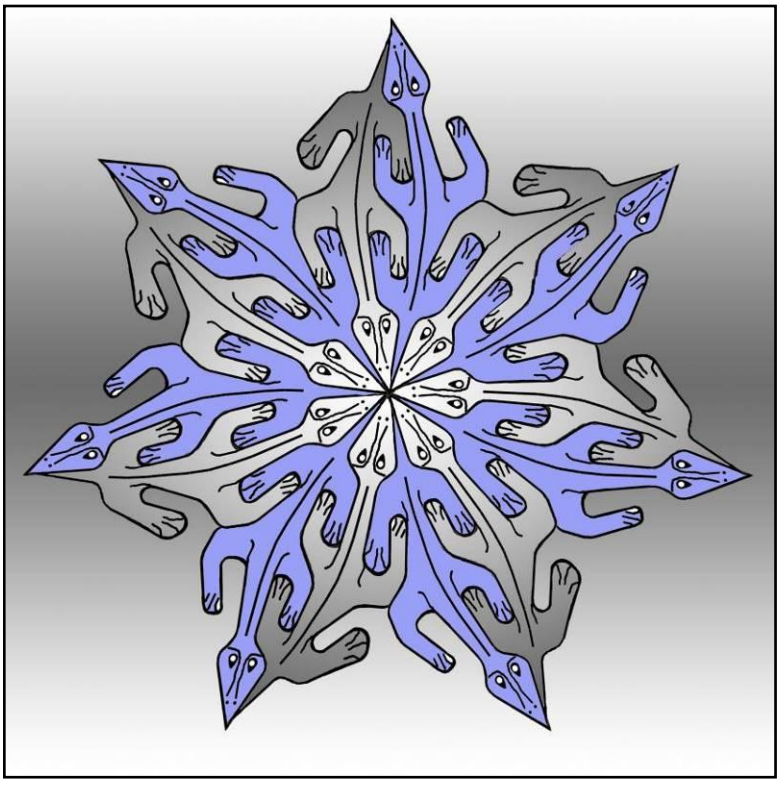
Triangle isocèle avec deux angles à la base de 30° : une rotation et une symétrie centrale

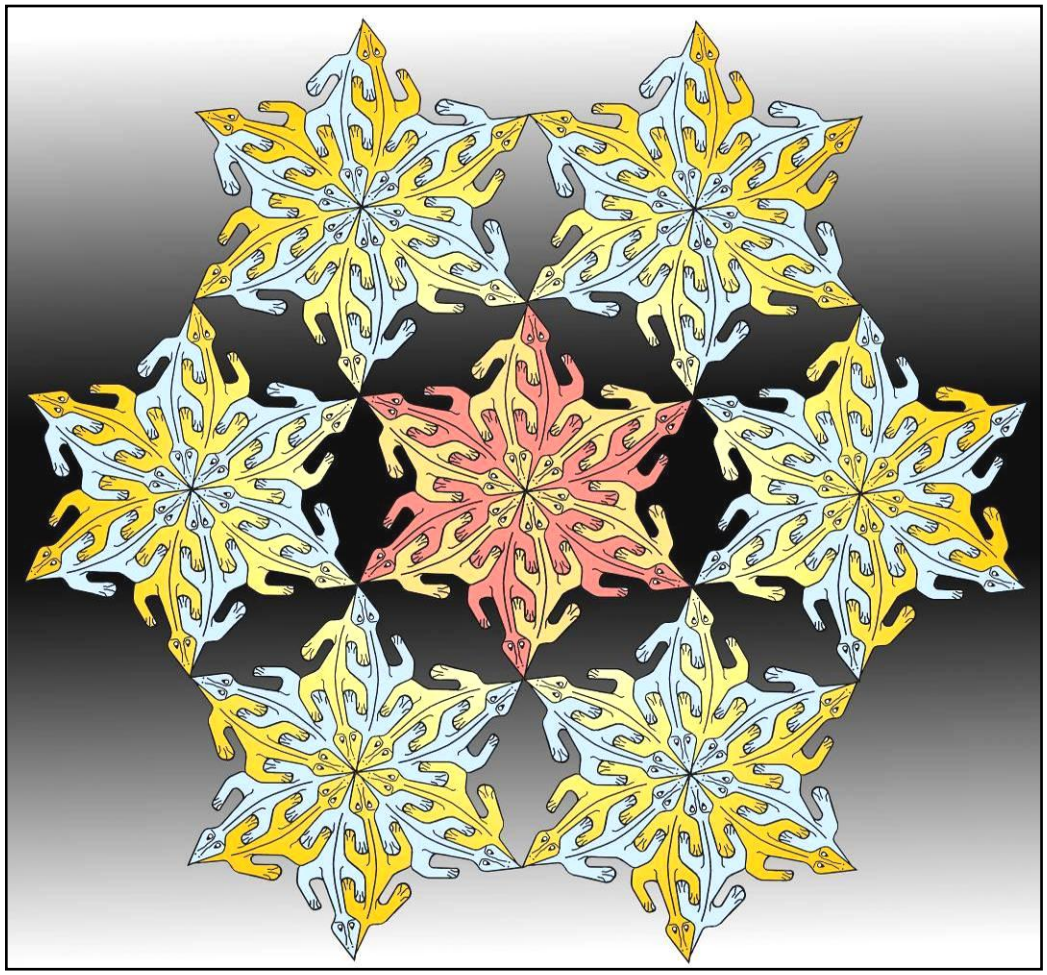


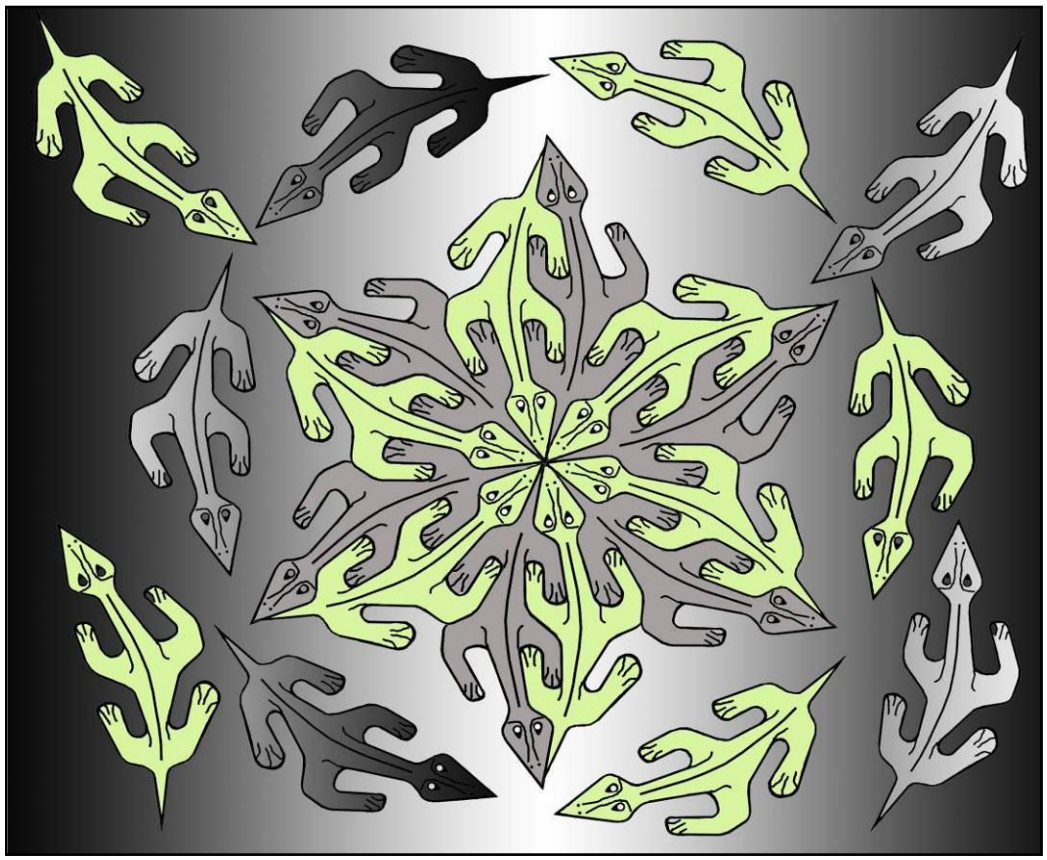
CONSTRUCTION

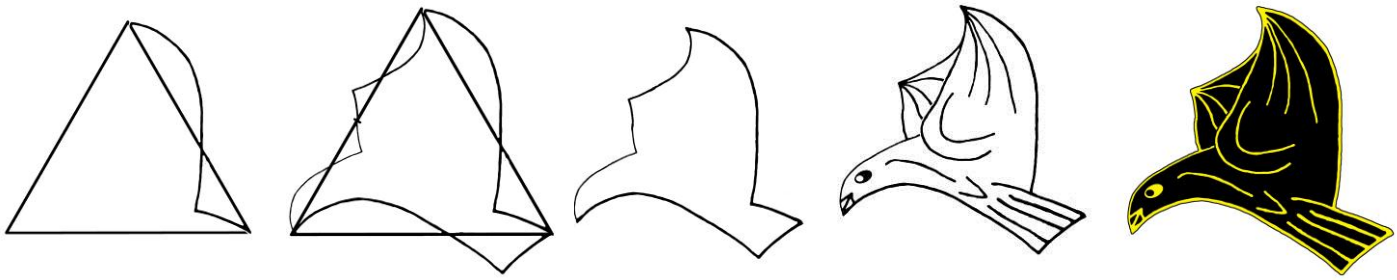
Une tête au centre a été rajoutée au modèle ci-contre en utilisant une transformation polaire.



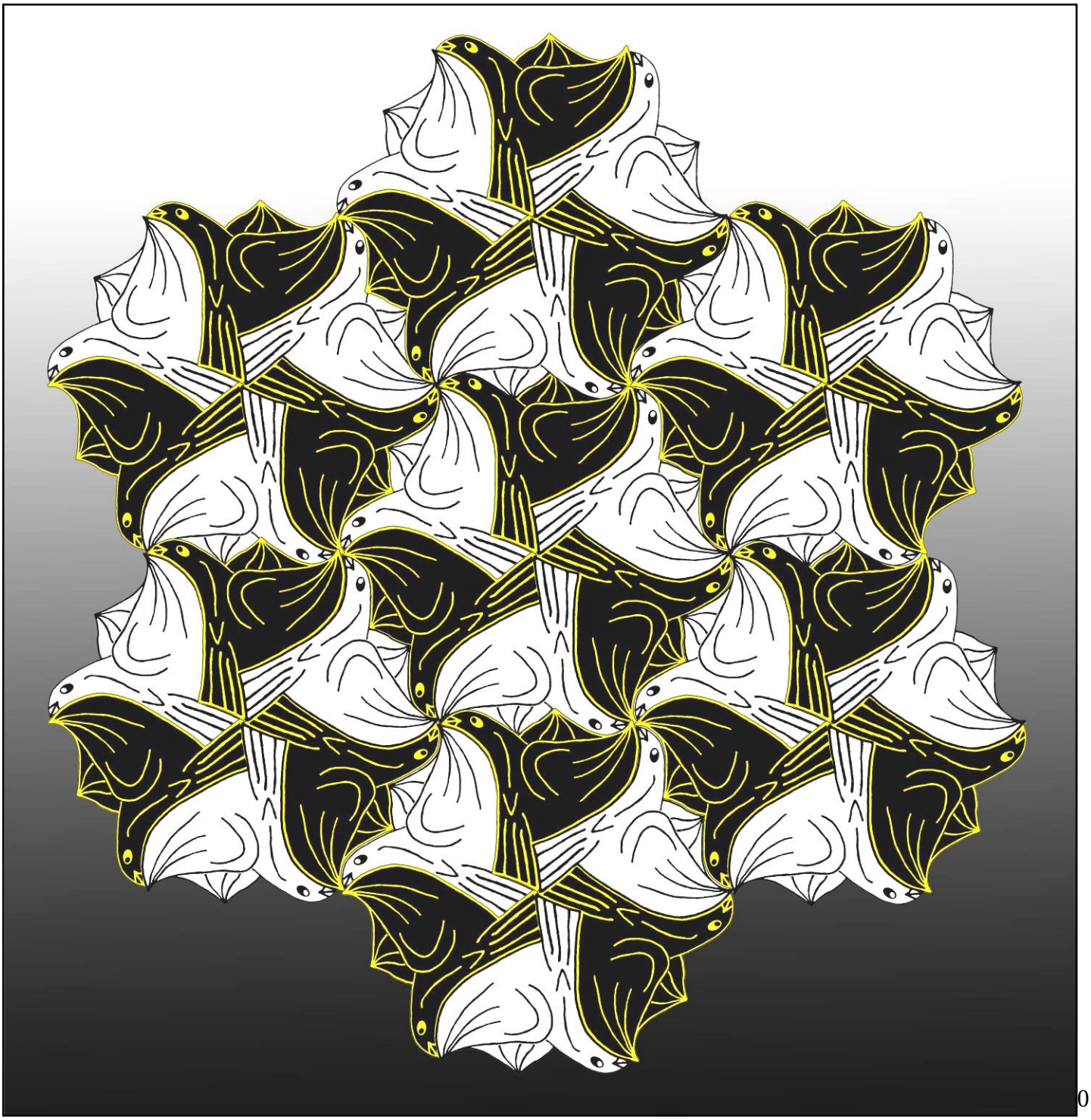


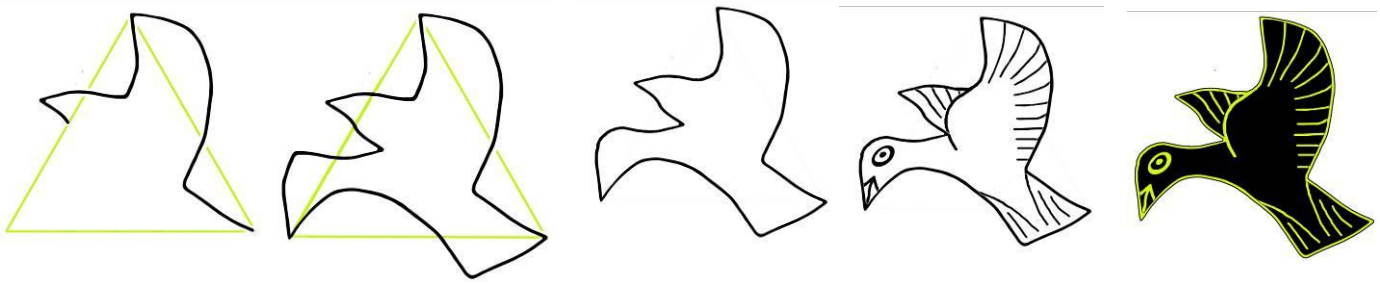






Triangle équilatéral : une rotation et une symétrie centrale d'un demi côté sur le troisième côté.

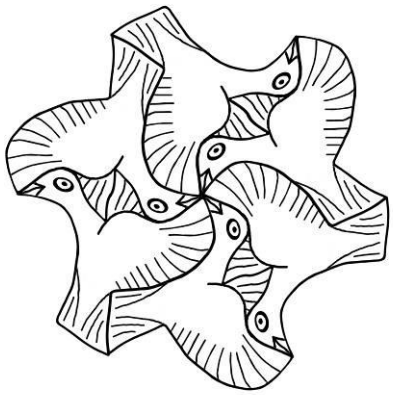


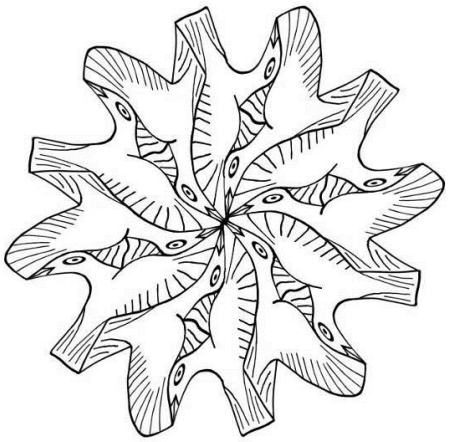


Triangle équilatéral : une rotation et une symétrie centrale d'un demi côté sur le troisième côté.

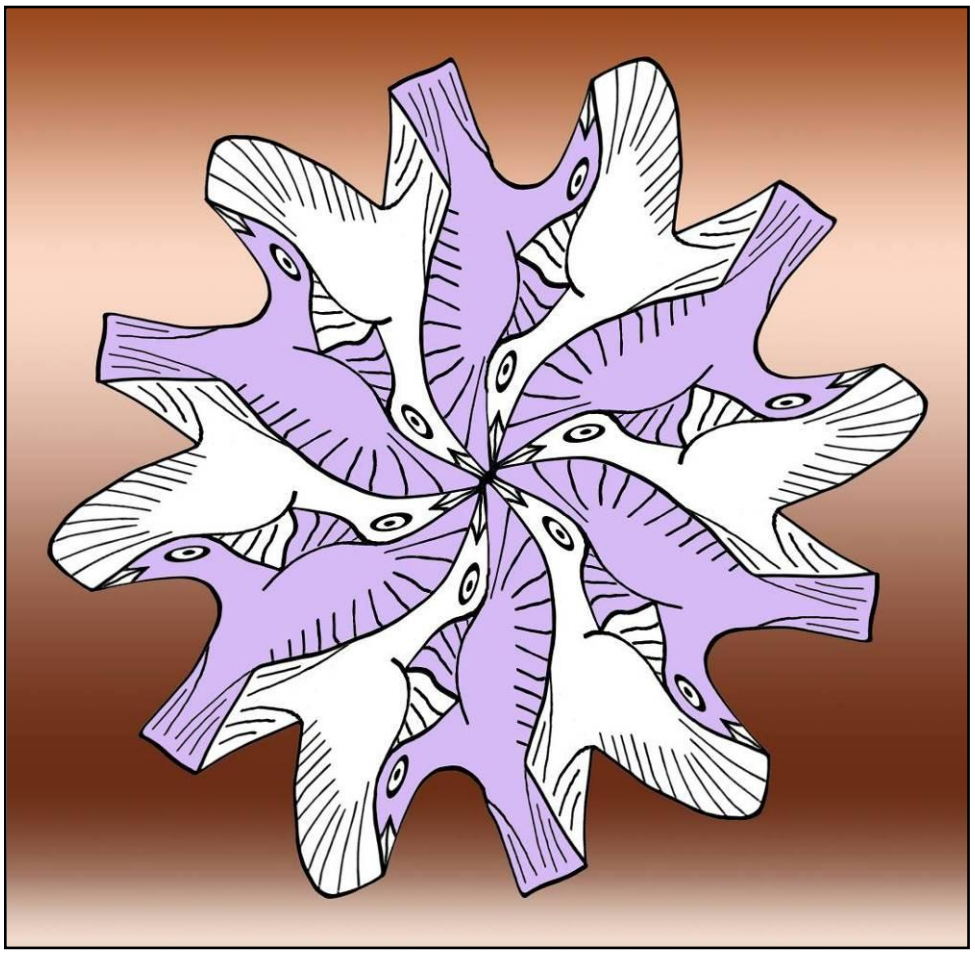
CONSTRUCTION

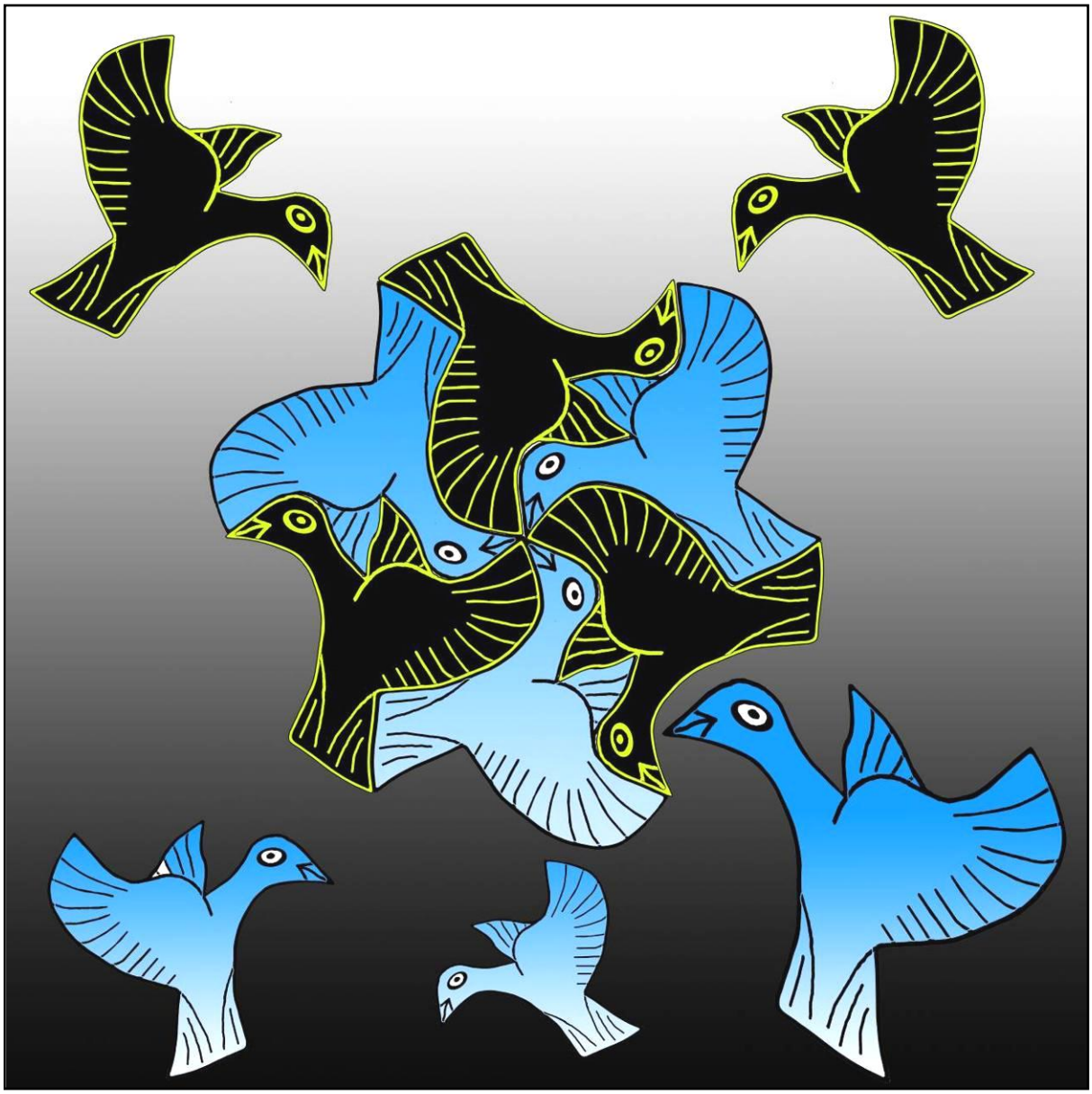
CONSTRUCTION

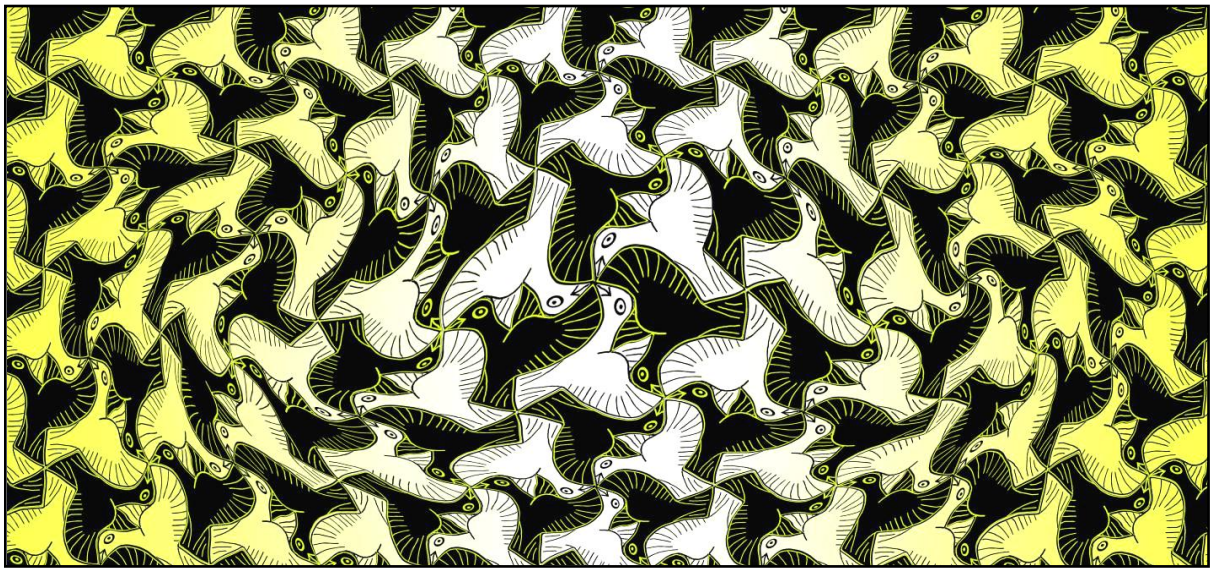


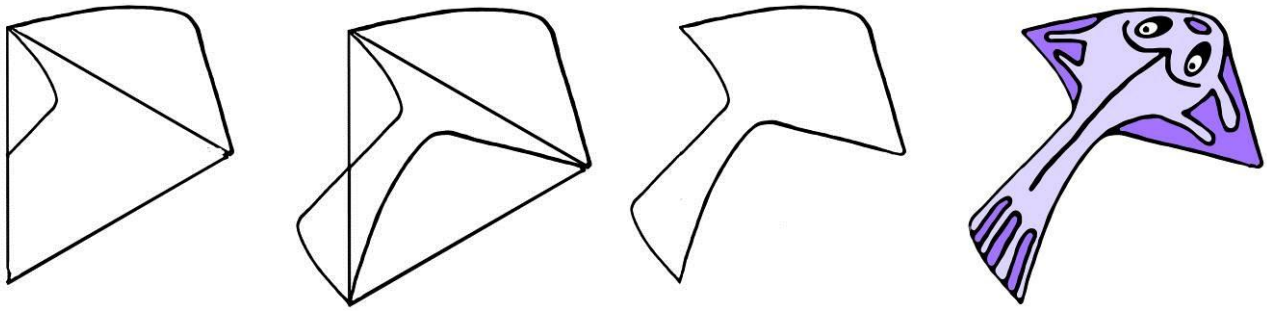


Transformation polaire : trois tête au centre en six têtes au centre.

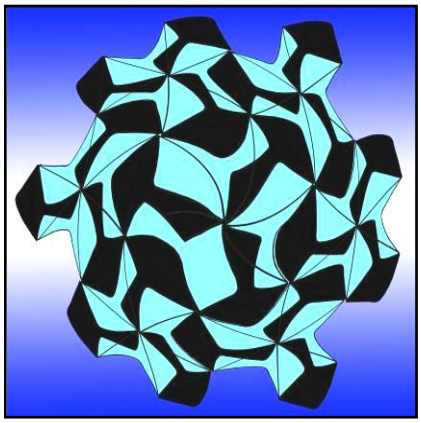


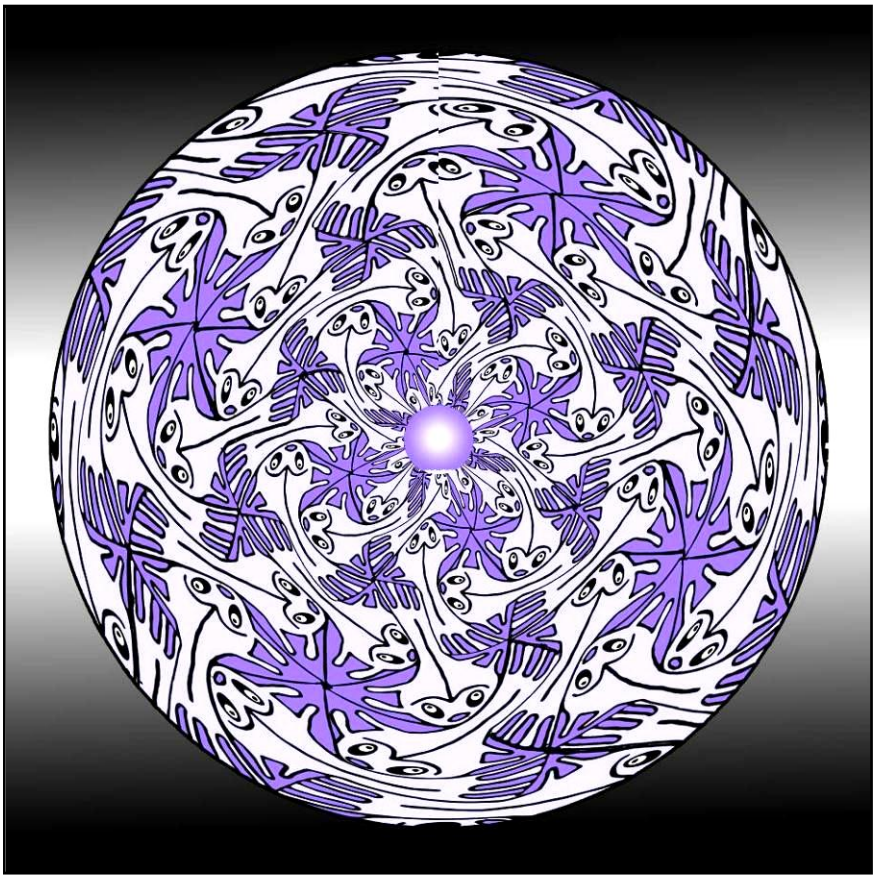


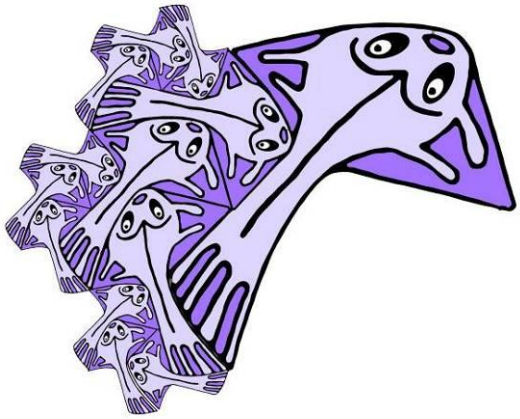


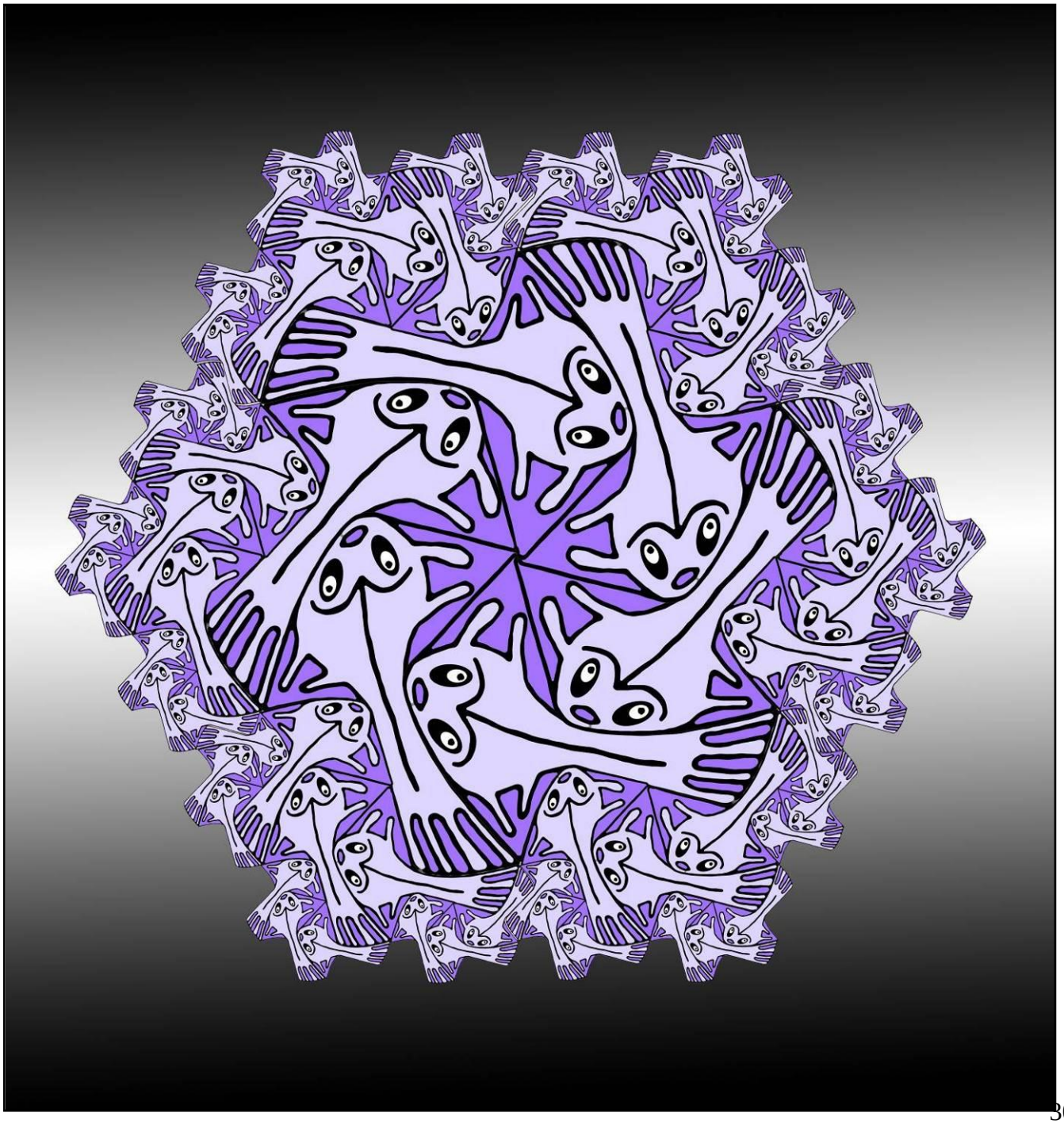


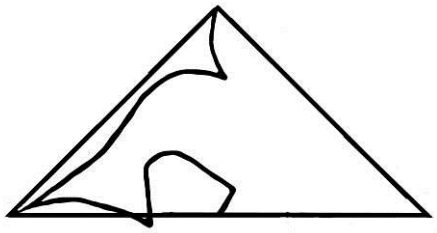
Triangle équilatéral : une rotation et une symétrie centrale d'un demi côté sur le troisième côté.

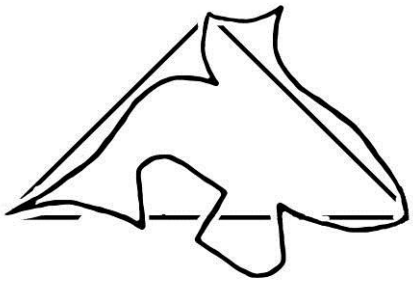


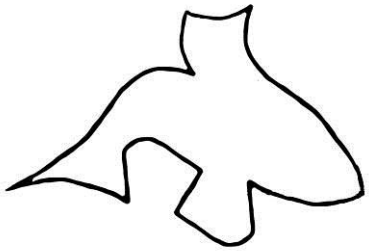


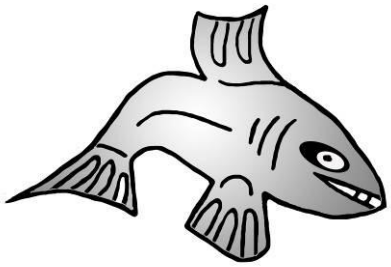








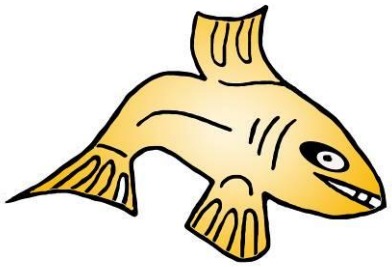


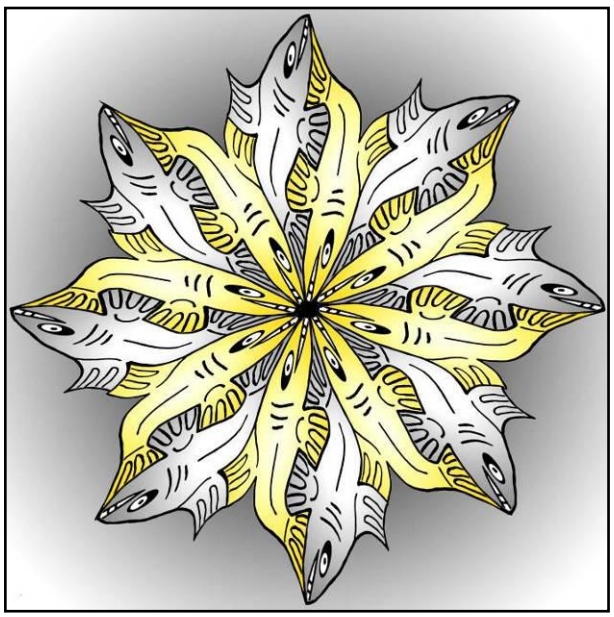


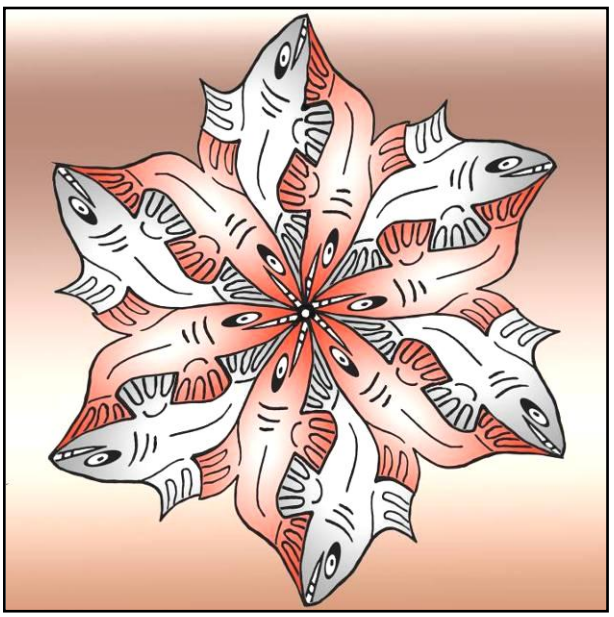
CONSTRUCTION

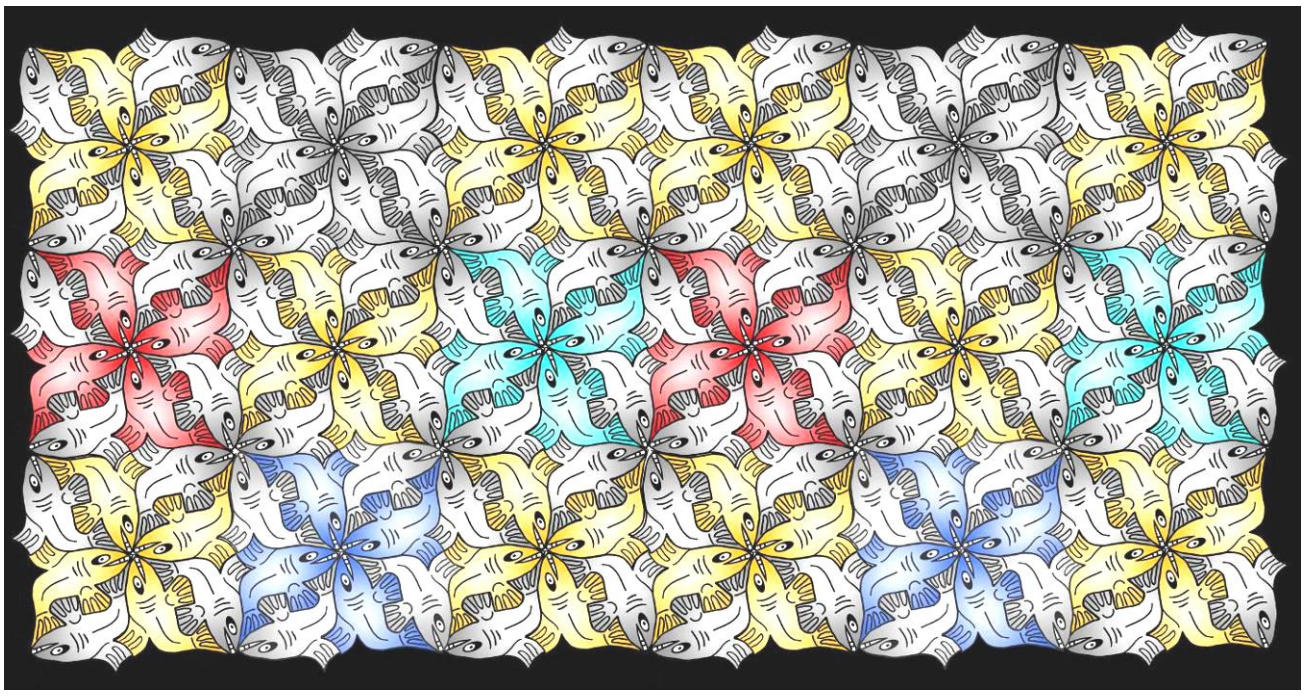
CONSTRUCTION

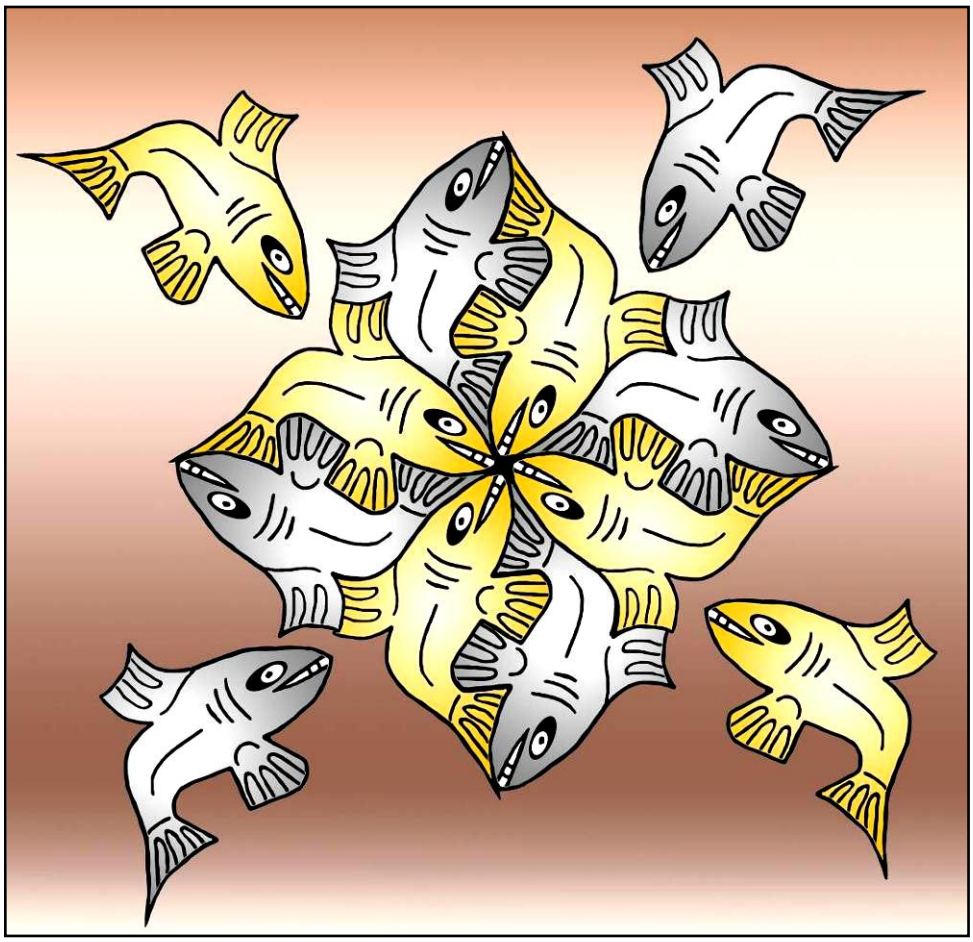
Triangle isocèle rectangle : une rotation et une symétrie centrale.

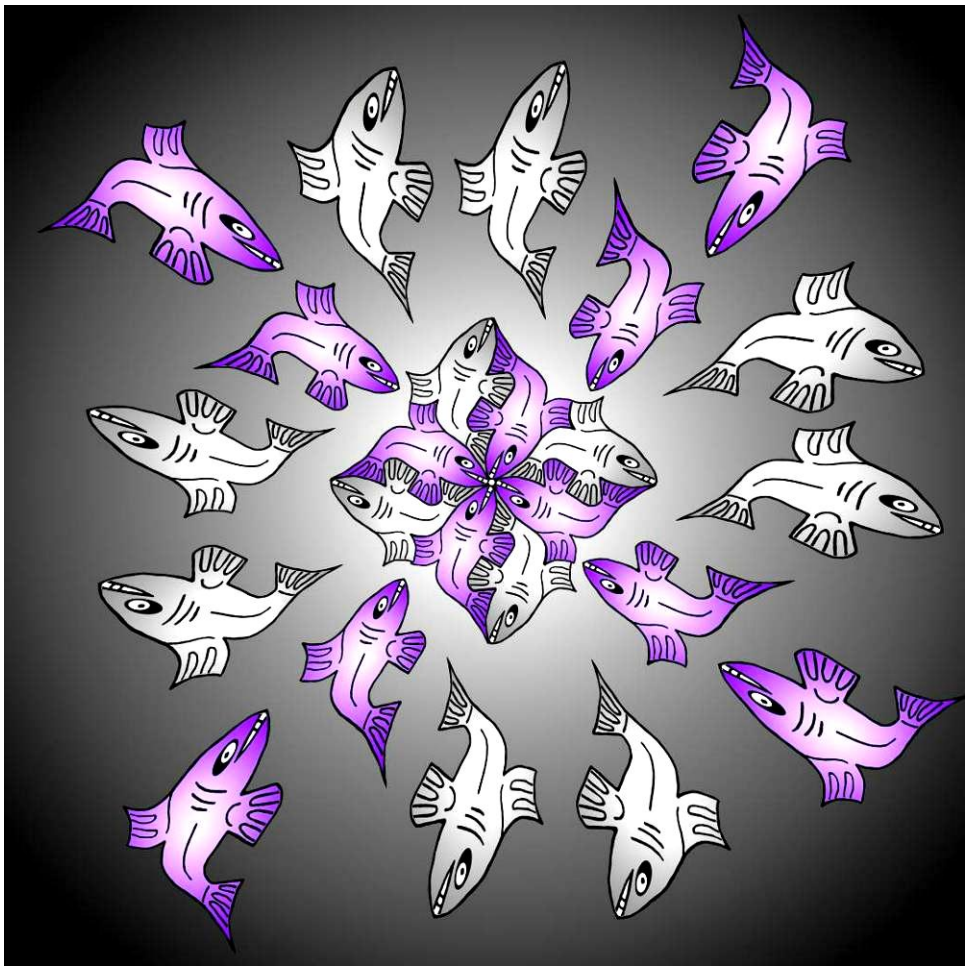




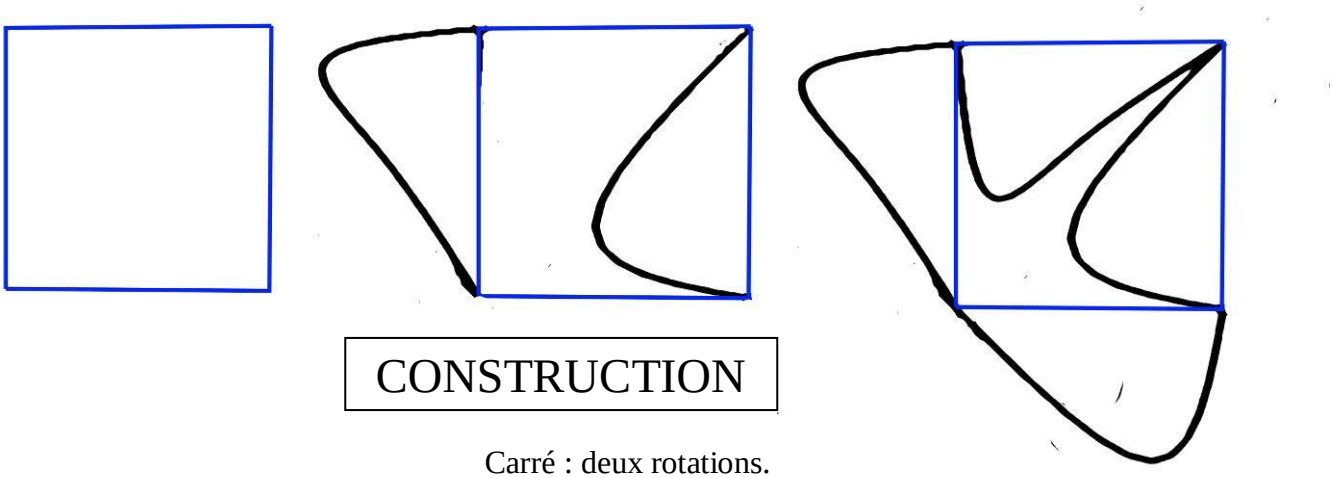






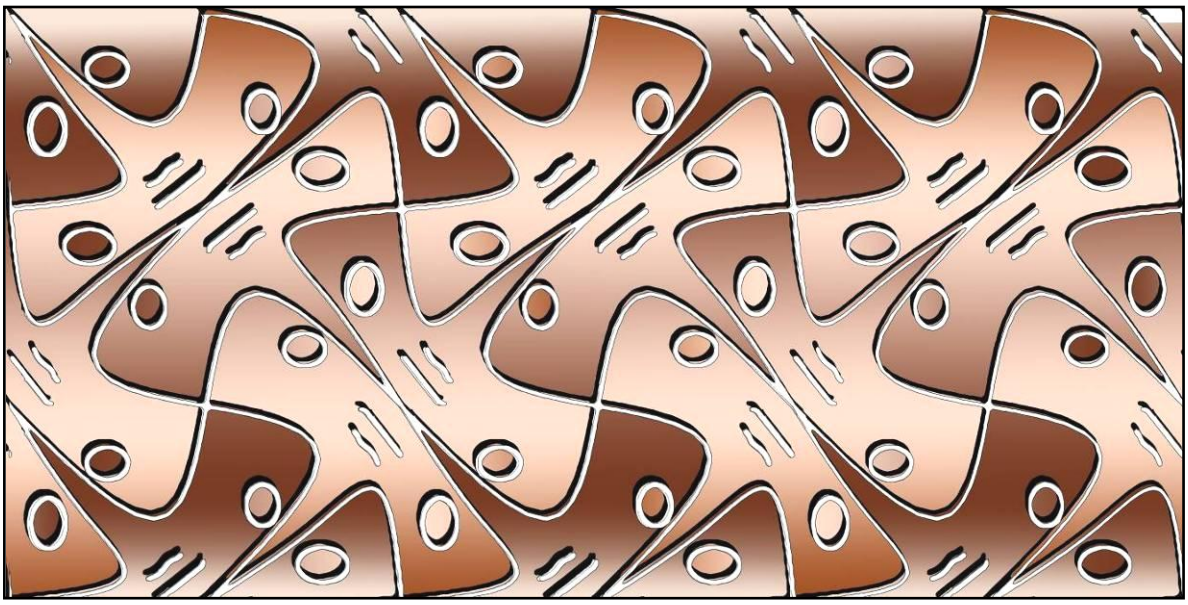


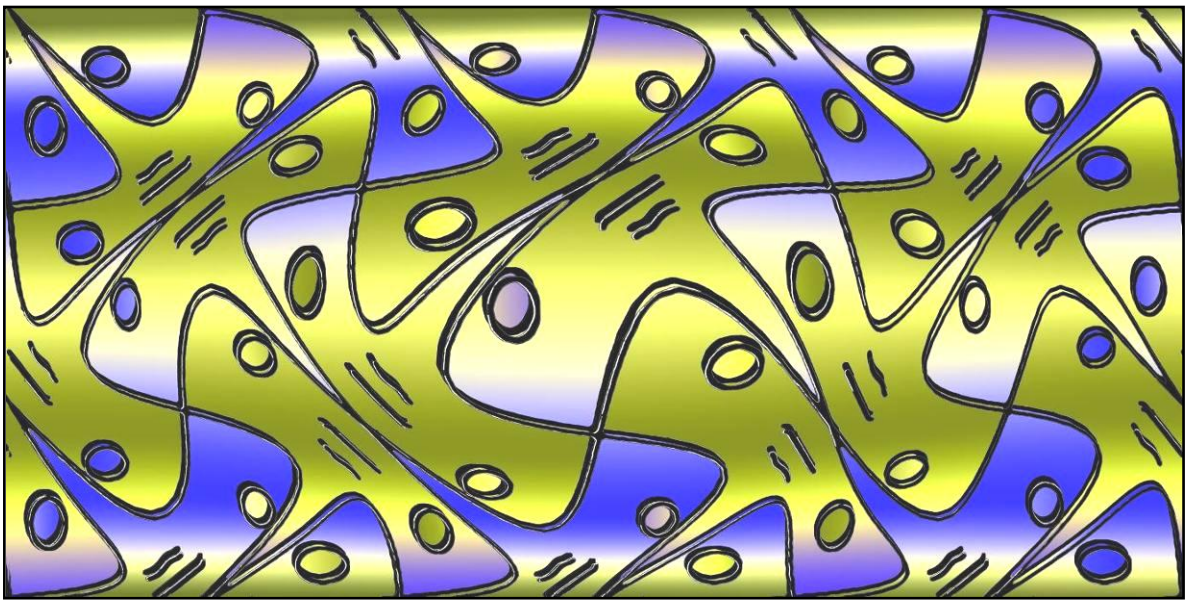
b) Les quadrilatères :

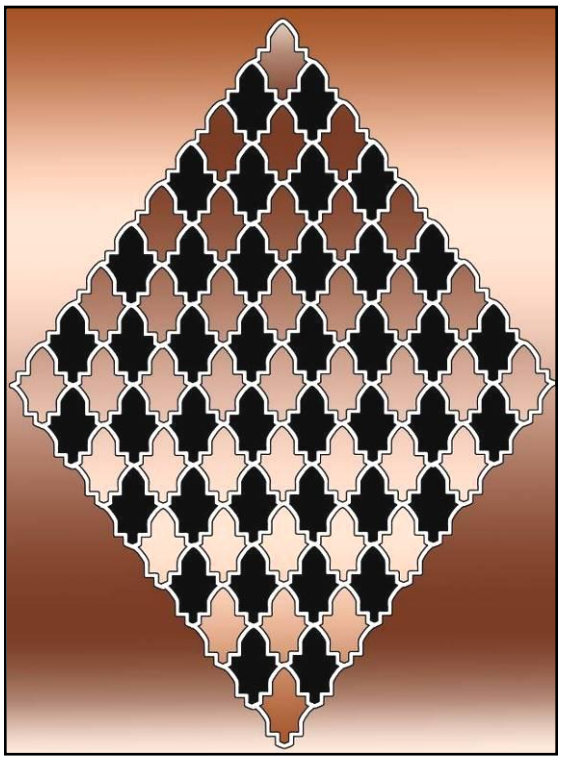


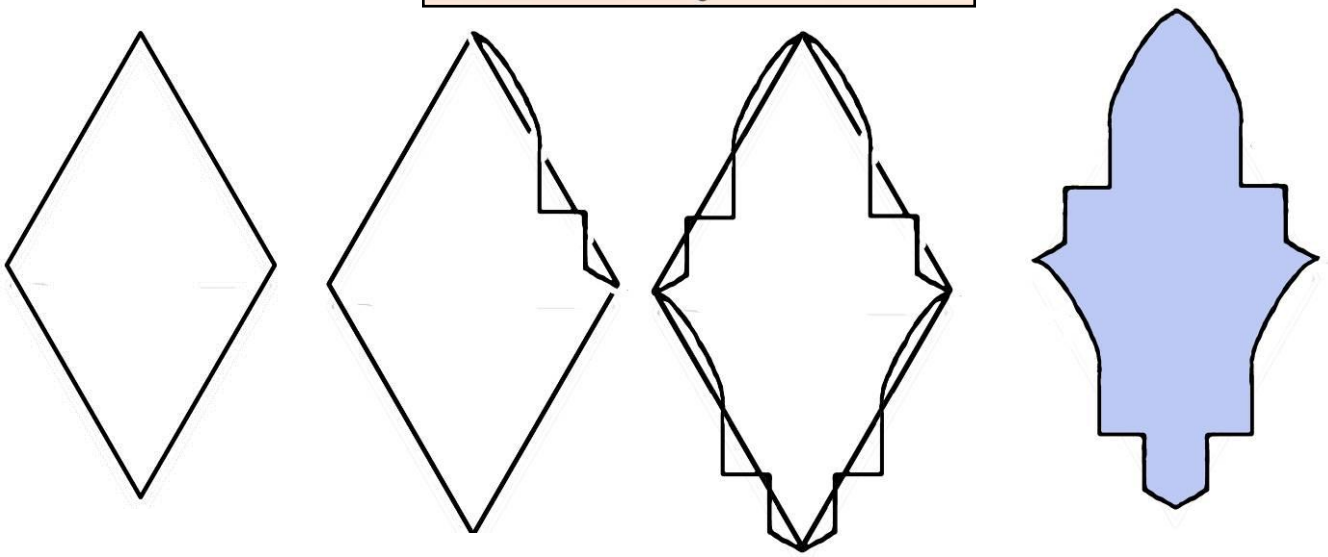
CONSTRUCTION

Carré : deux rotations.

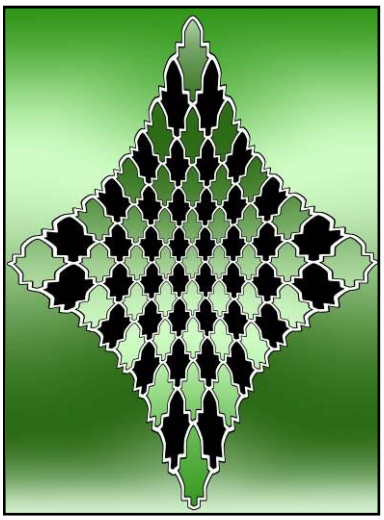


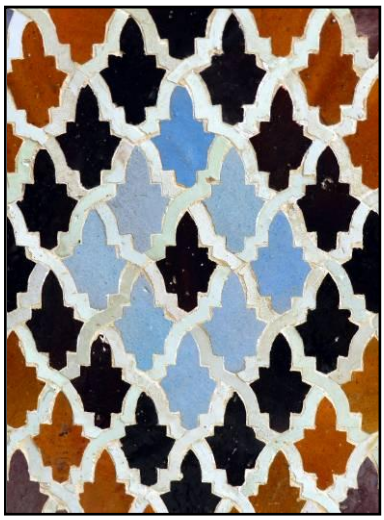


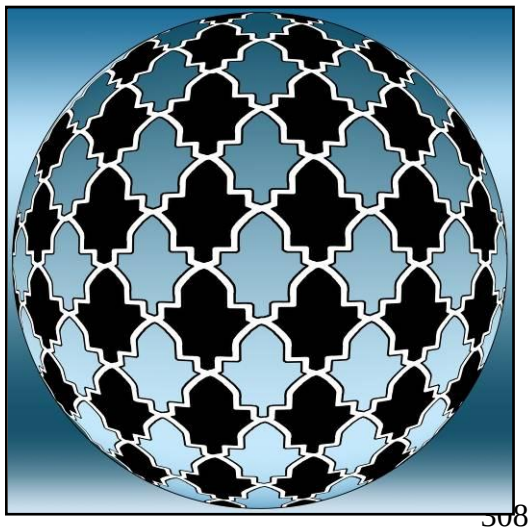


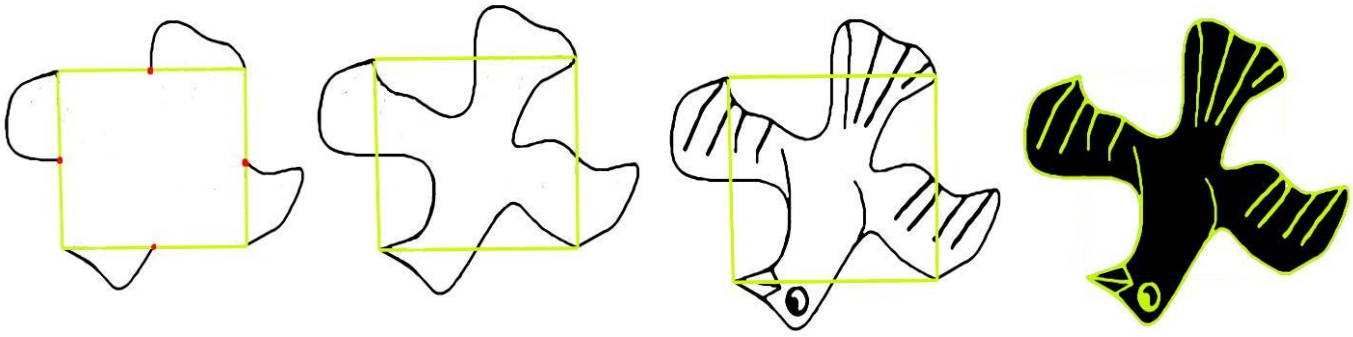


Losange équilatère : rotations et symétries.

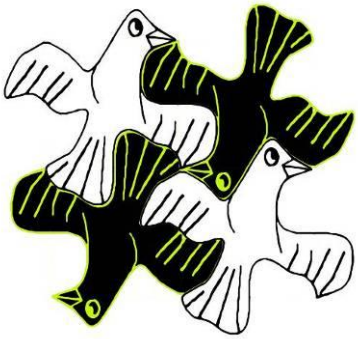




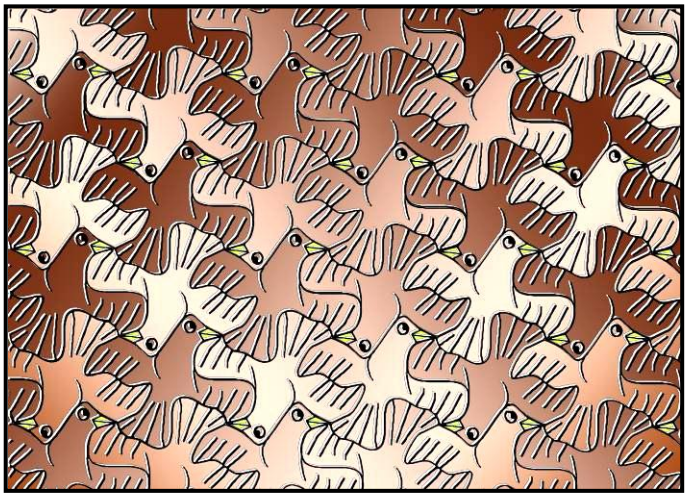


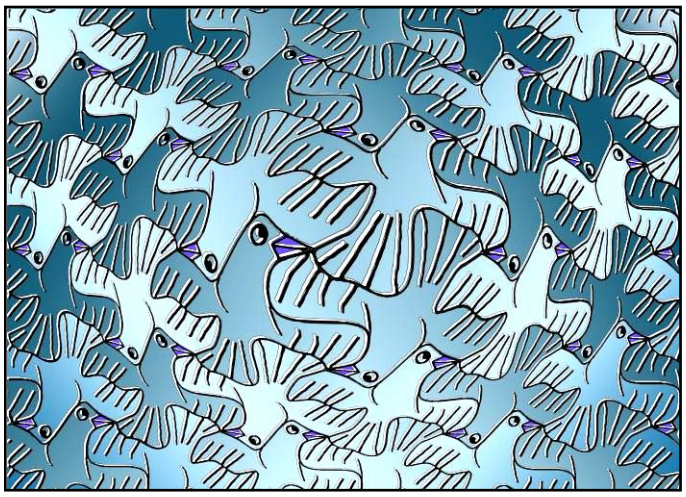


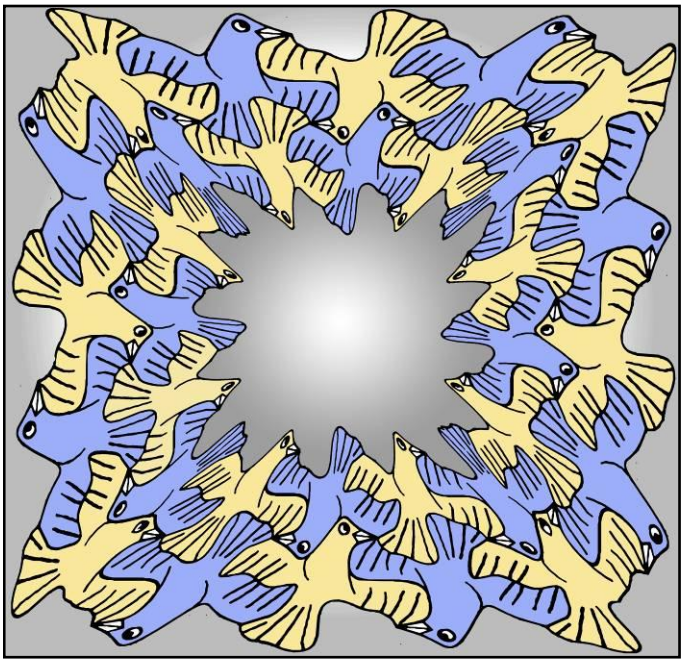
CONSTRUCTION

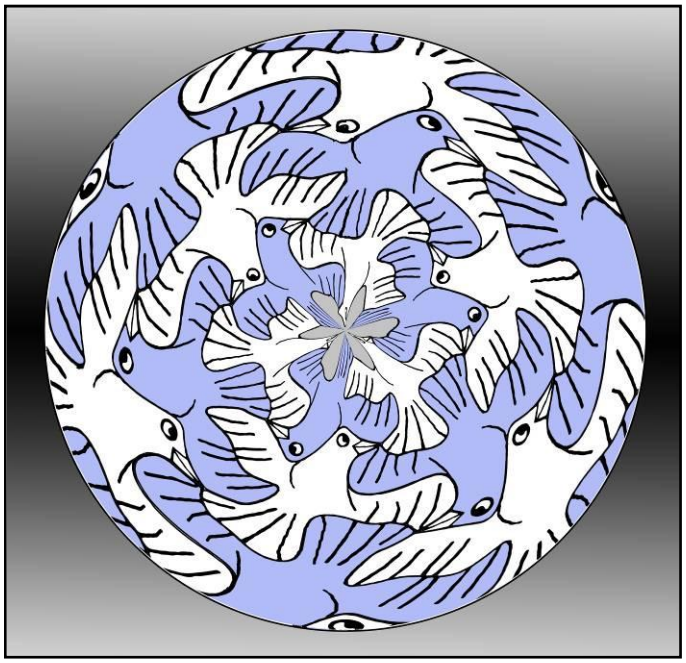


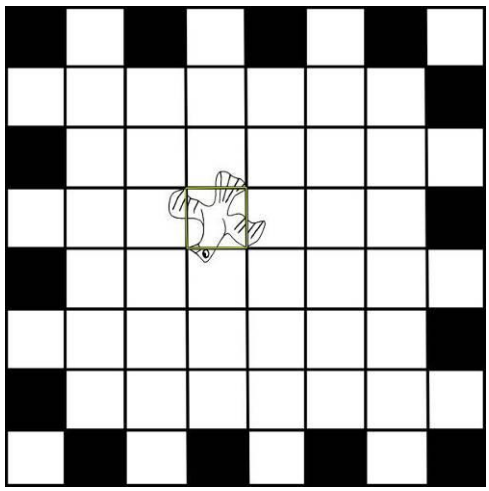
Carré : quatre symétries centrales

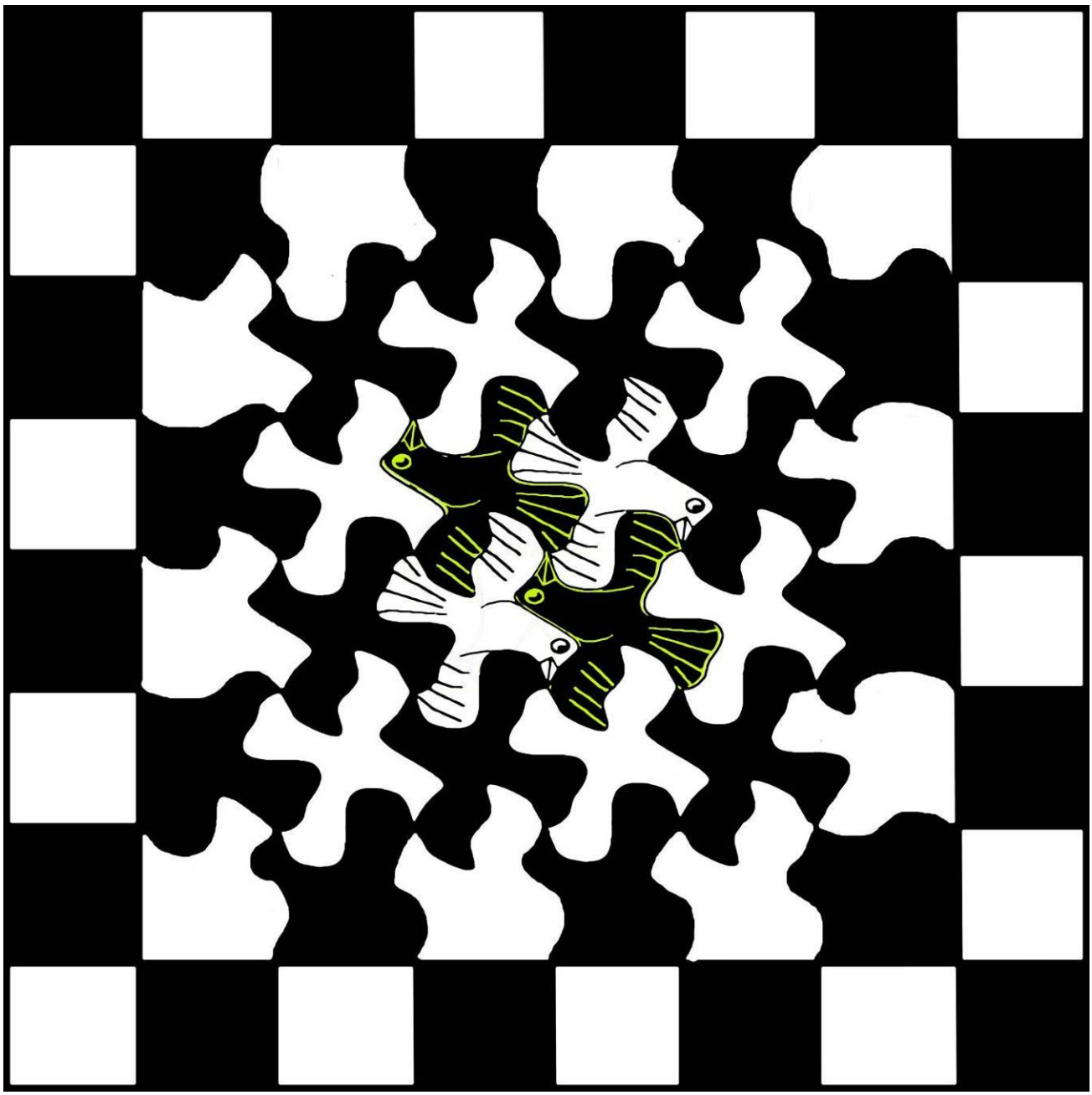


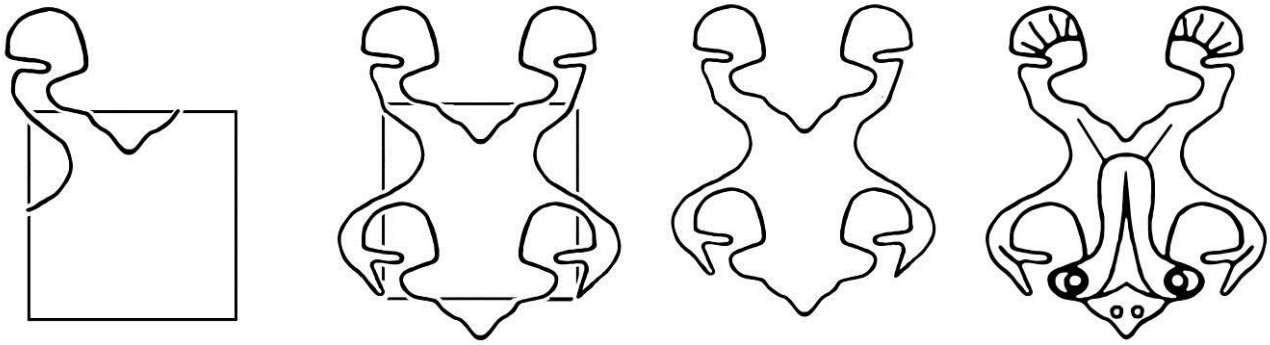




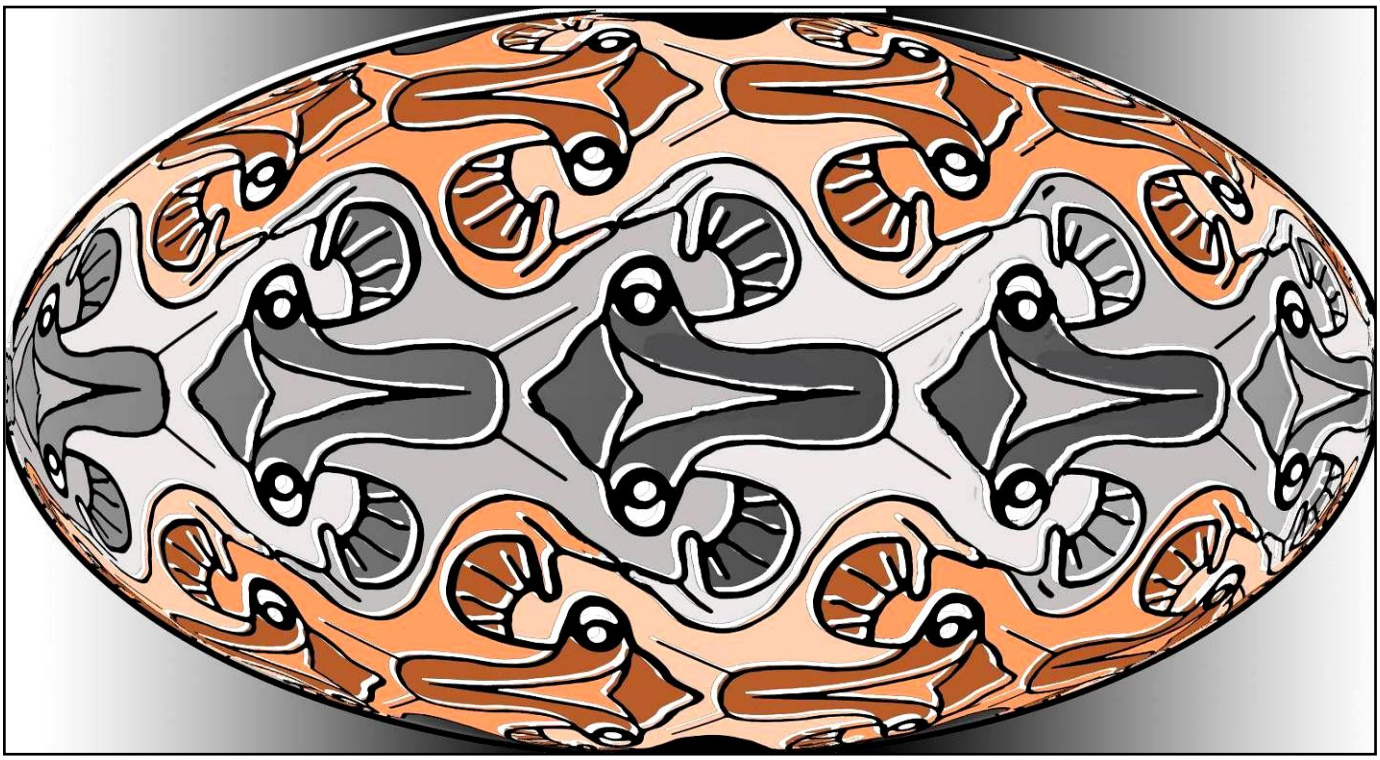


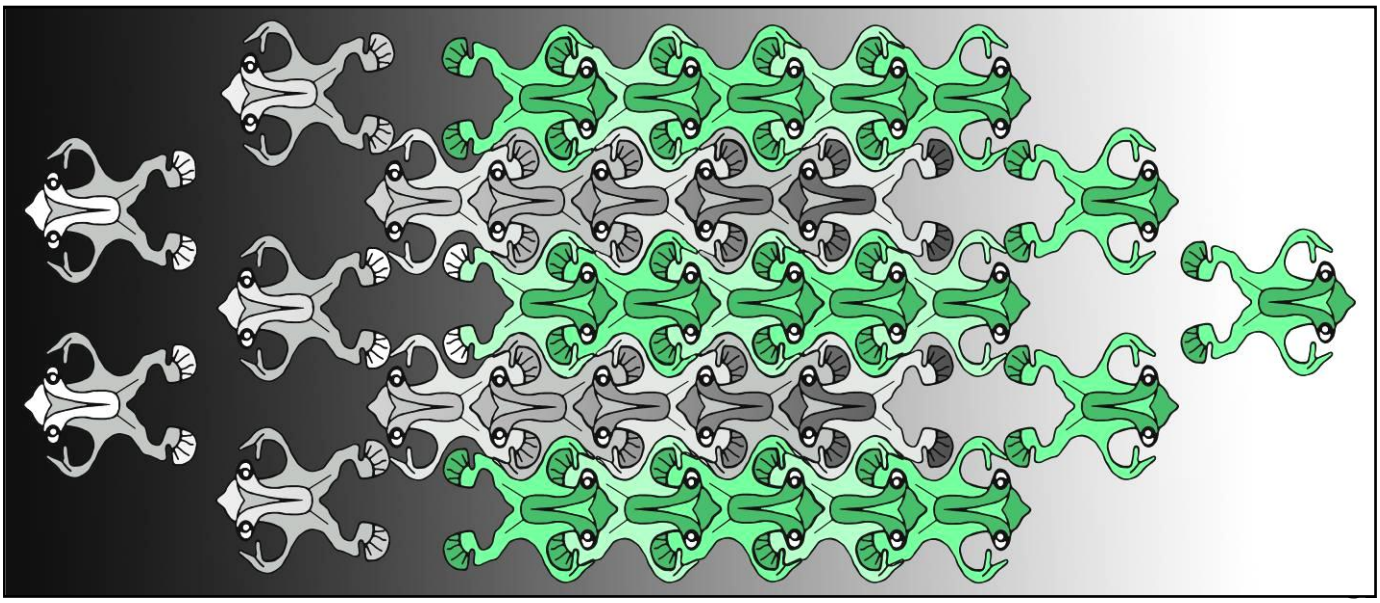


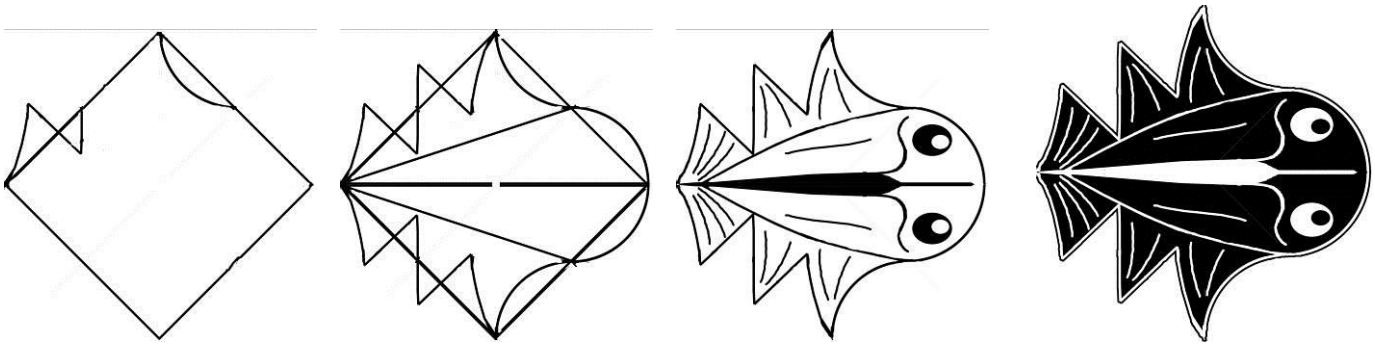




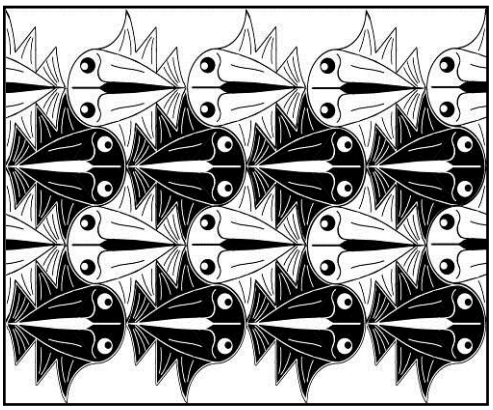
CONSTRUCTION



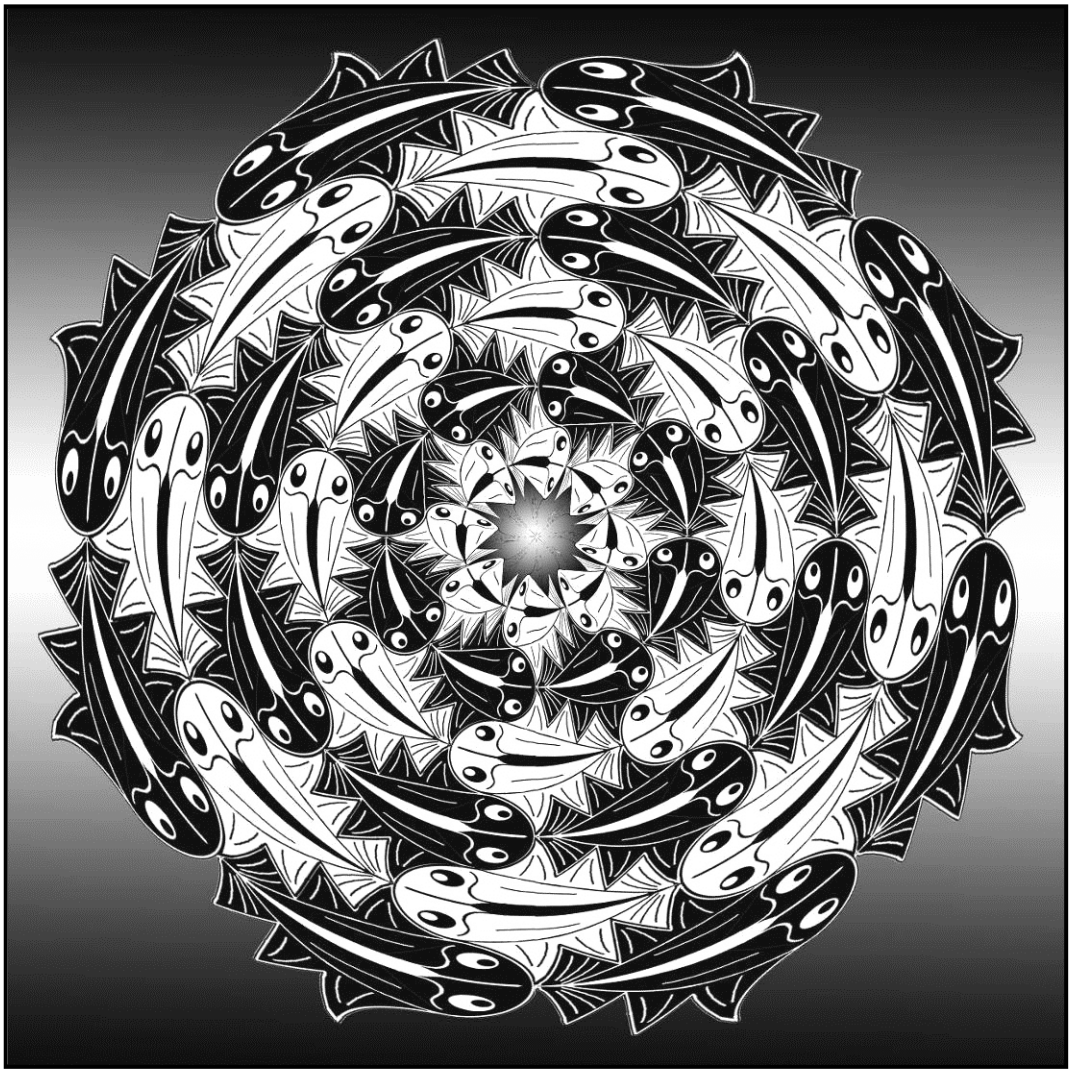


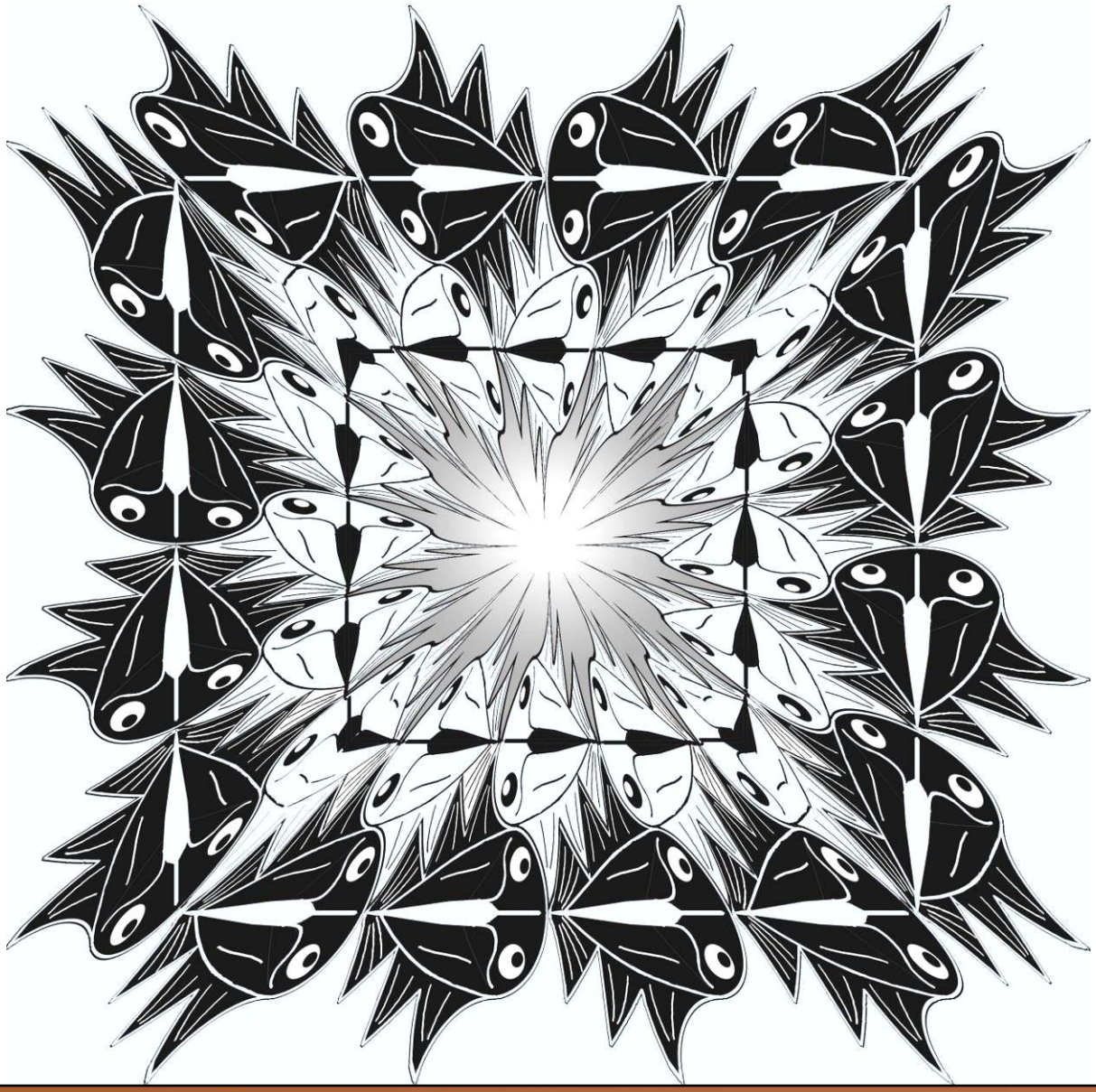


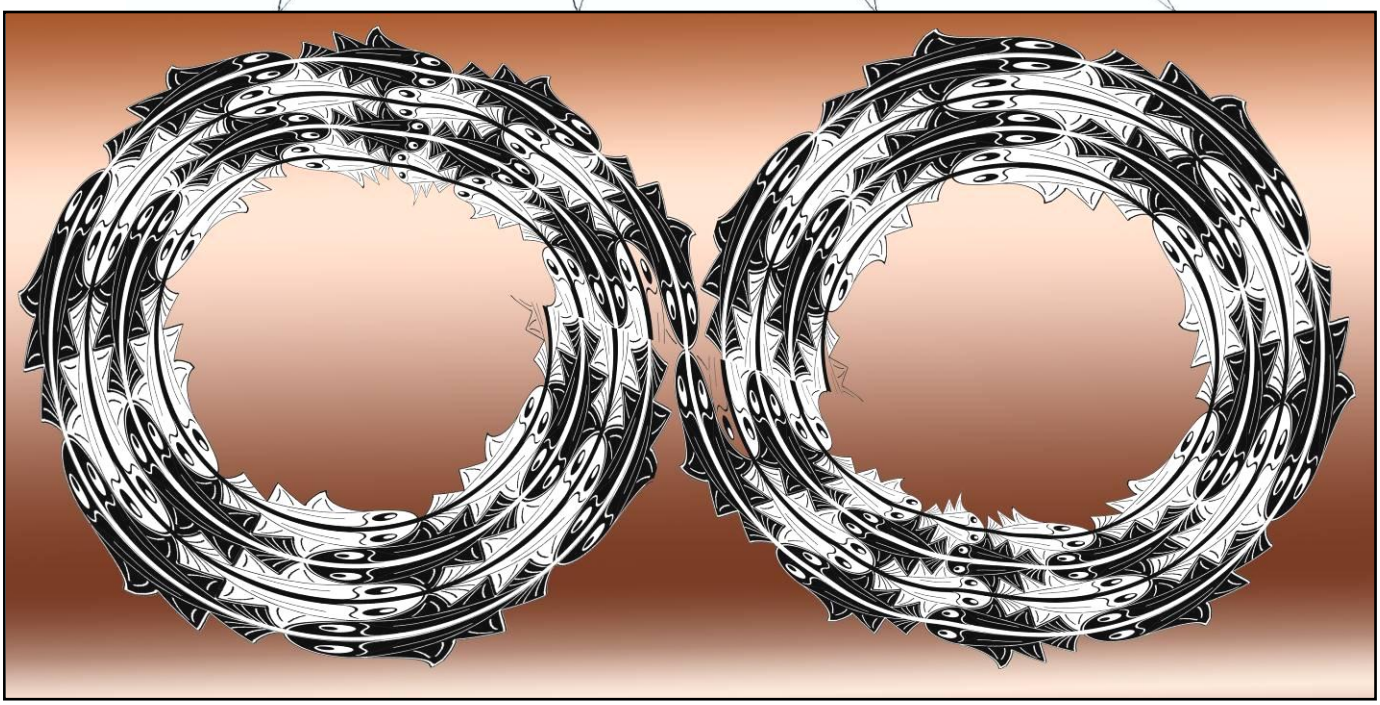
CONSTRUCTION

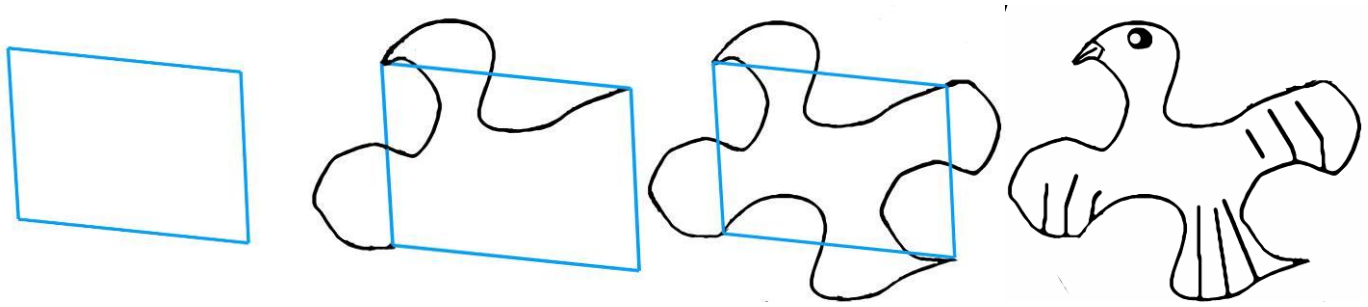


Carré : deux symétries centrales et une symétrie axiale d’axe horizontal.

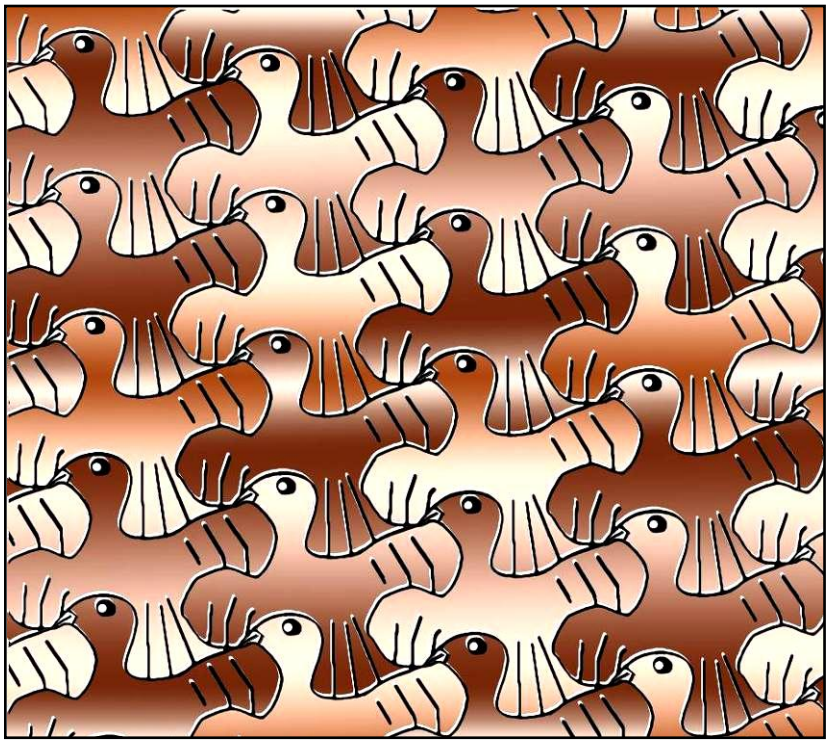


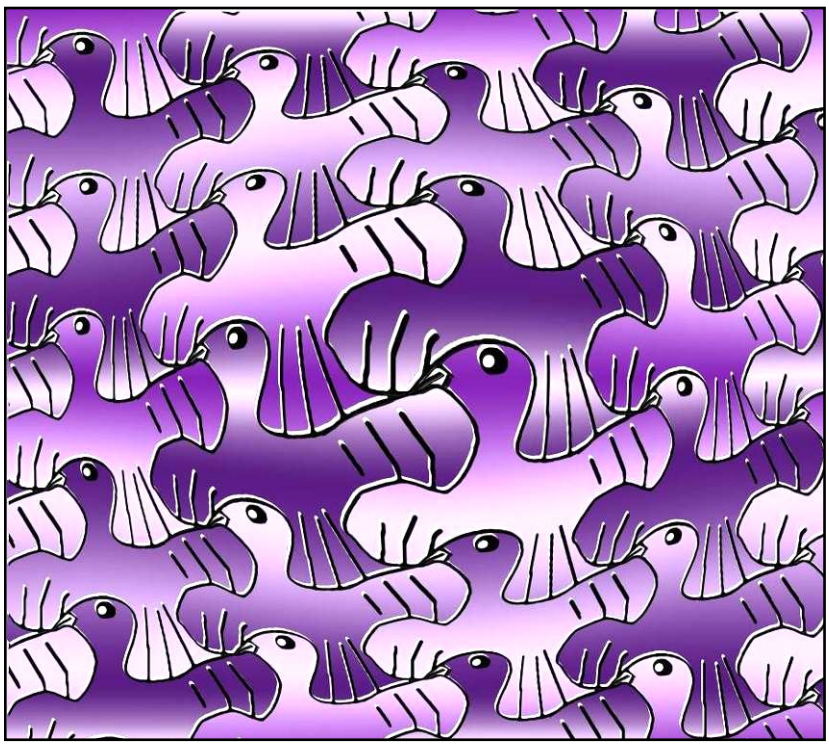


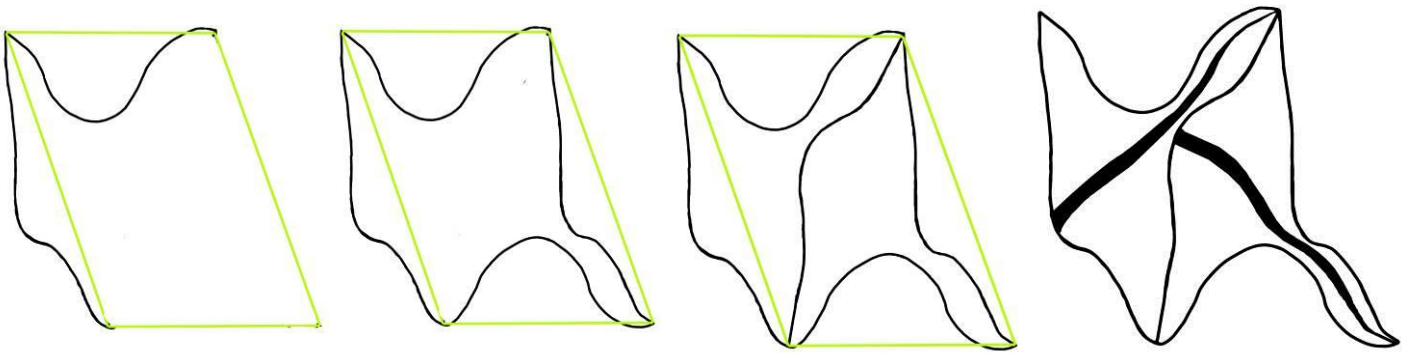




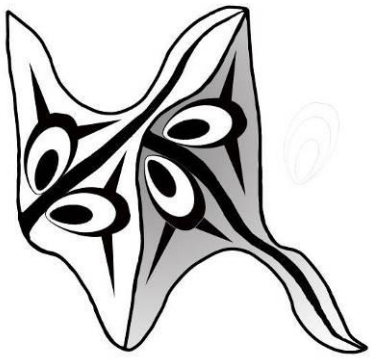
Carré : deux translations.



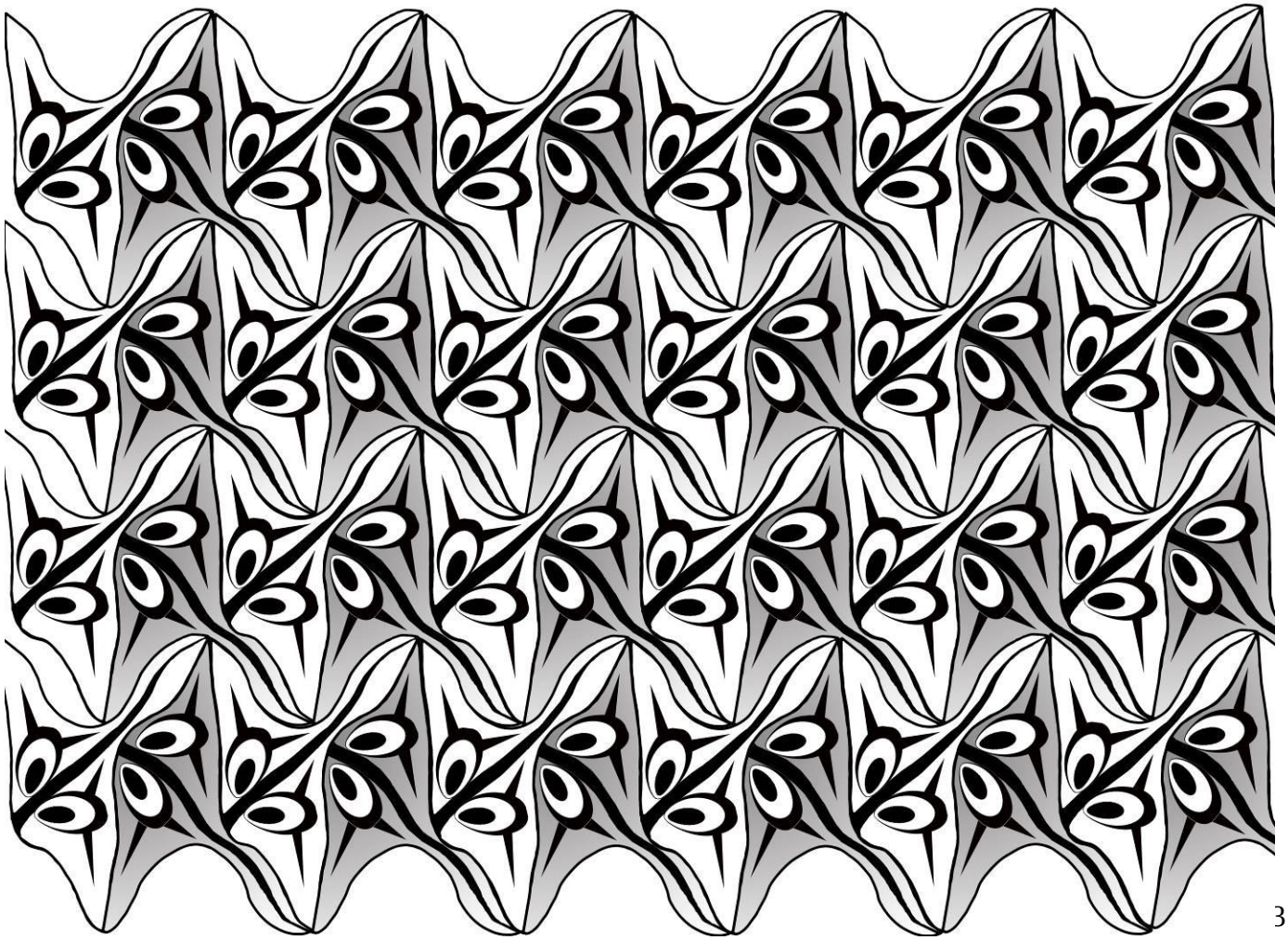


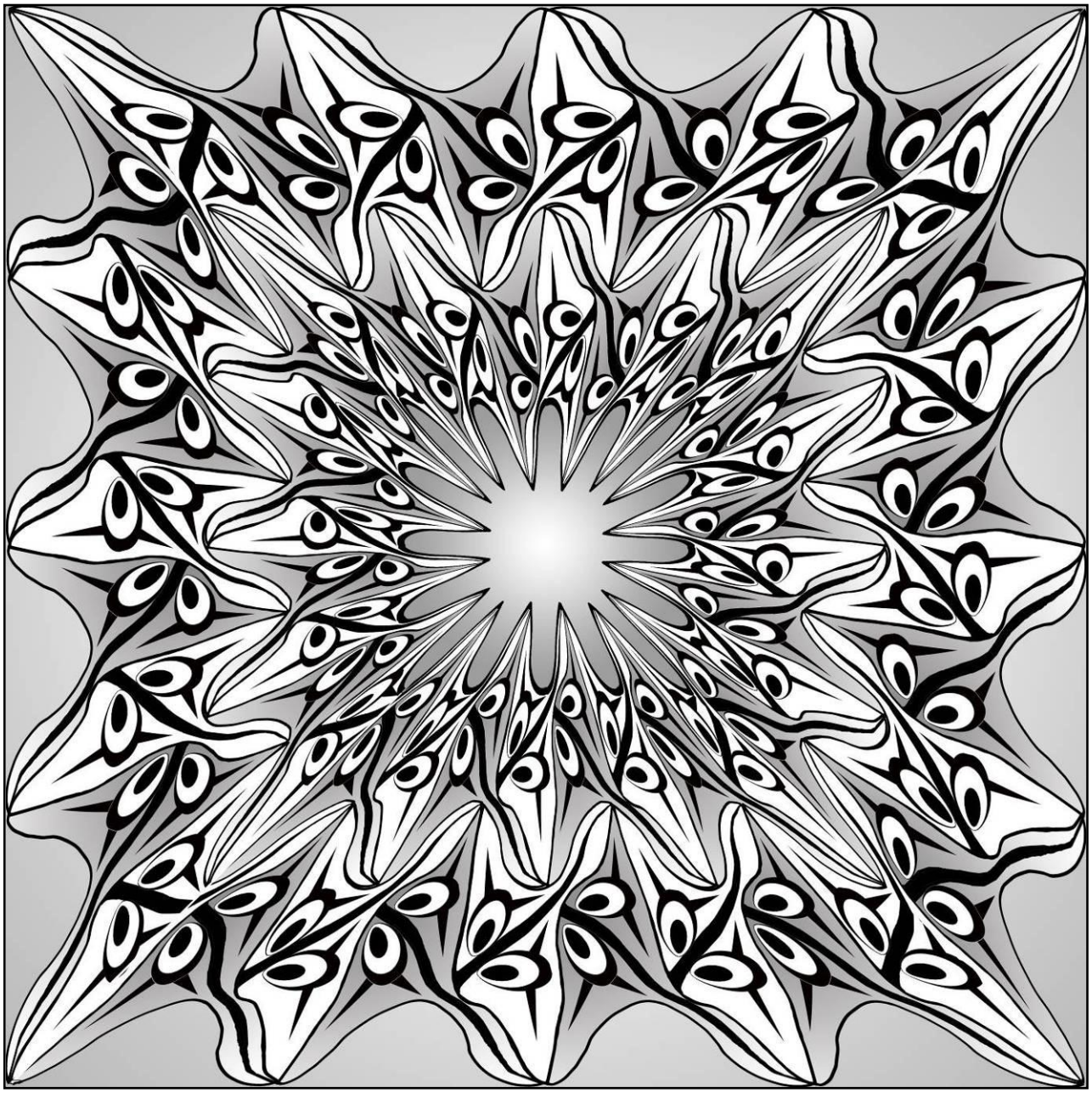


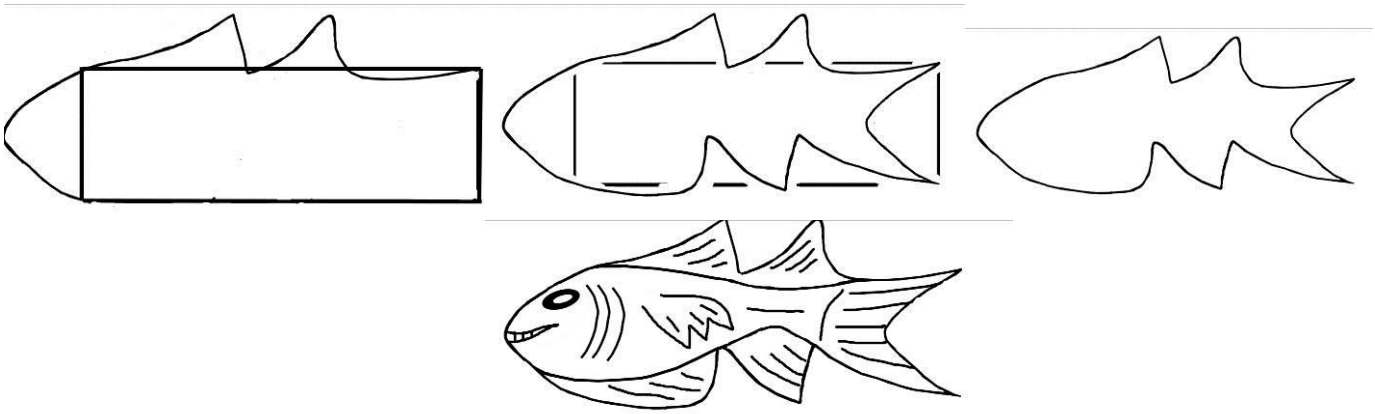
CONSTRUCTION



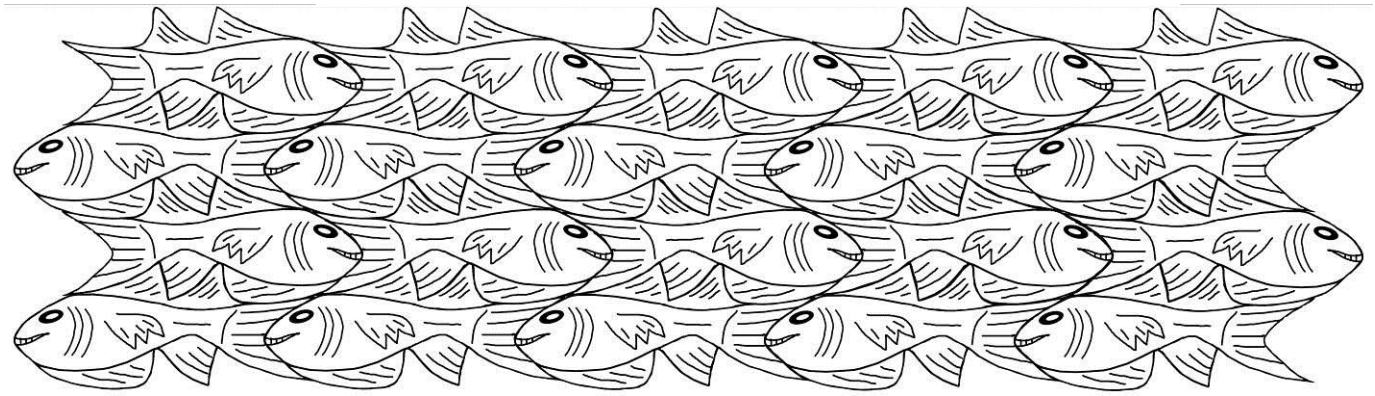
Parallélogramme : une translation et une symétrie axiale.



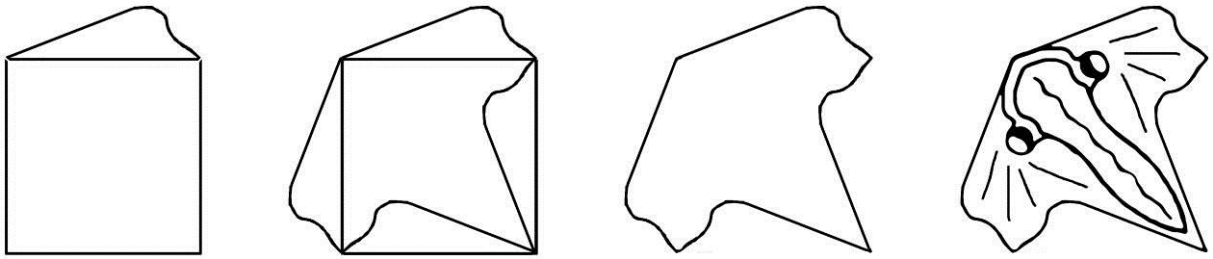




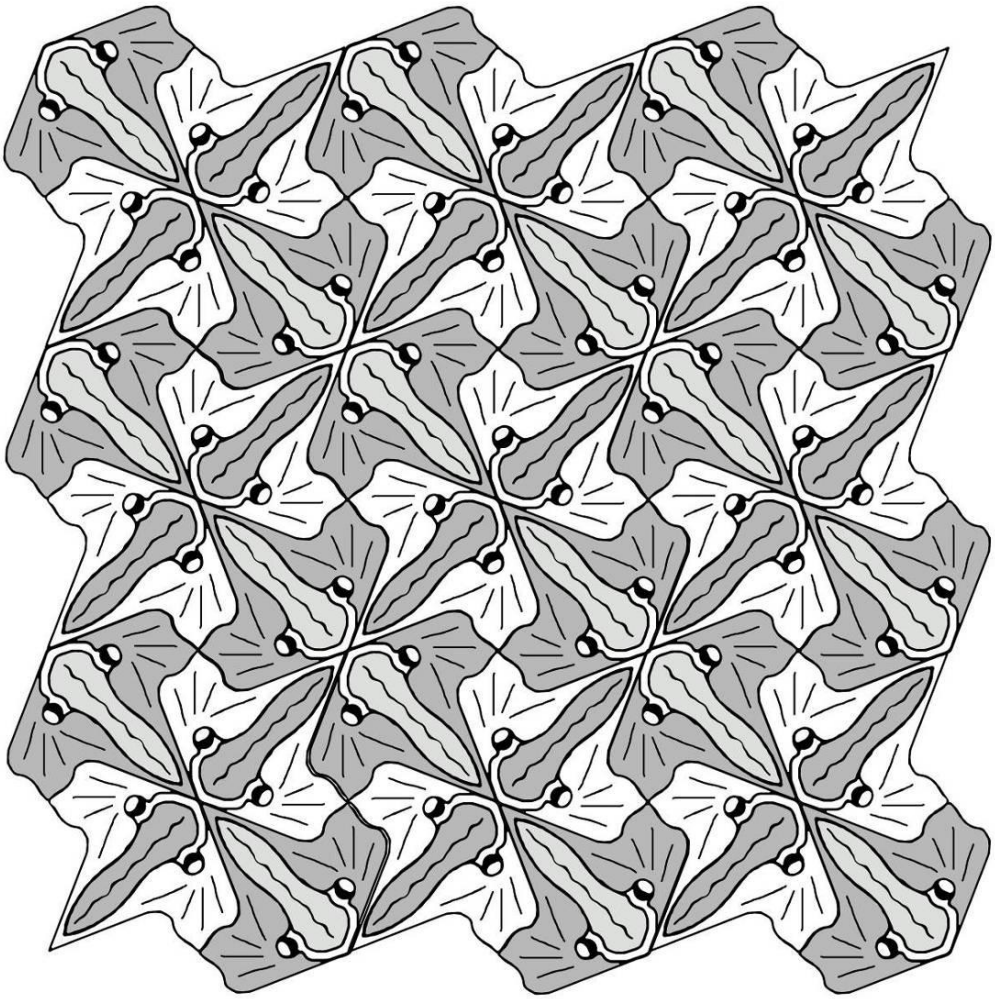
Rectangle : deux translations et une symétrie axiale.

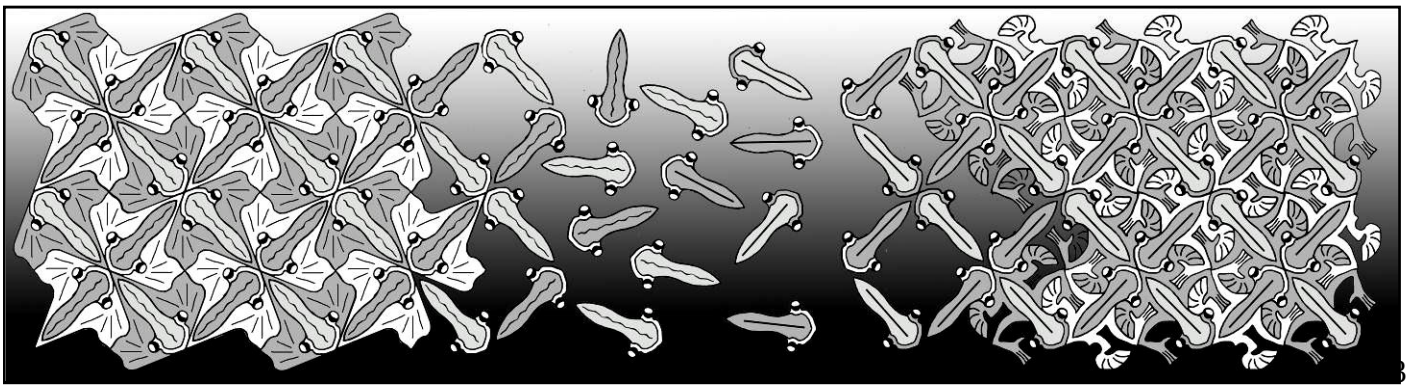


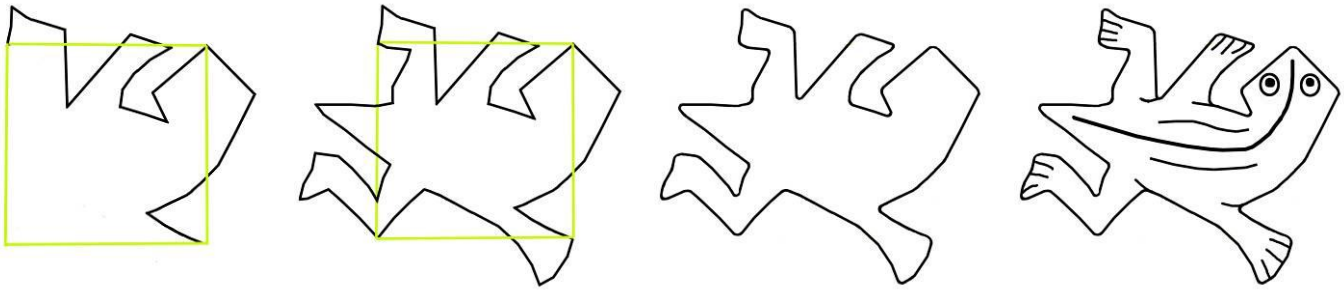
CONSTRUCTION



Carré : une rotation, une réflexion glissée et une rotation.

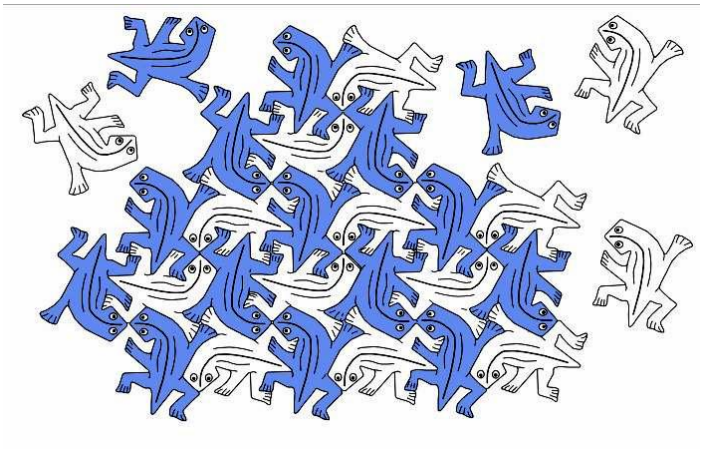


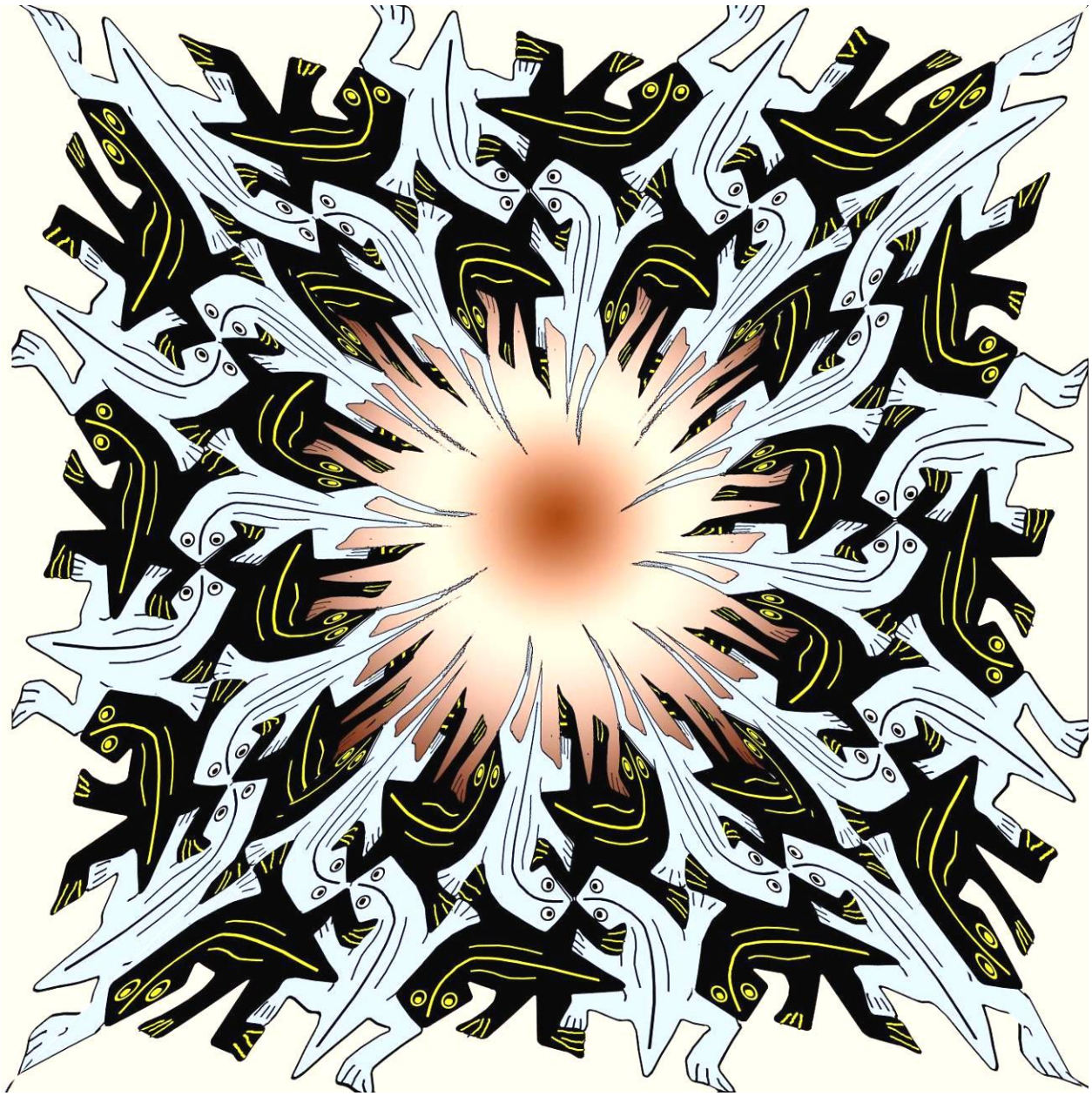




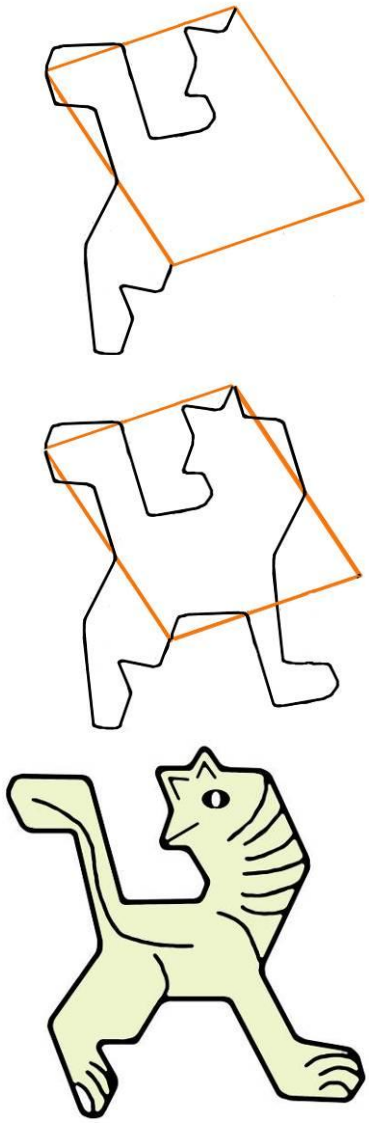
Carré : deux rotations à 90°.

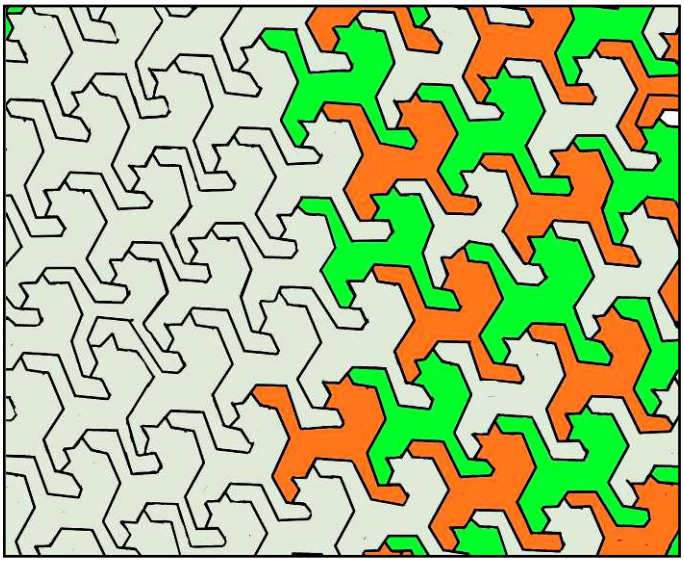
CONSTRUCTION

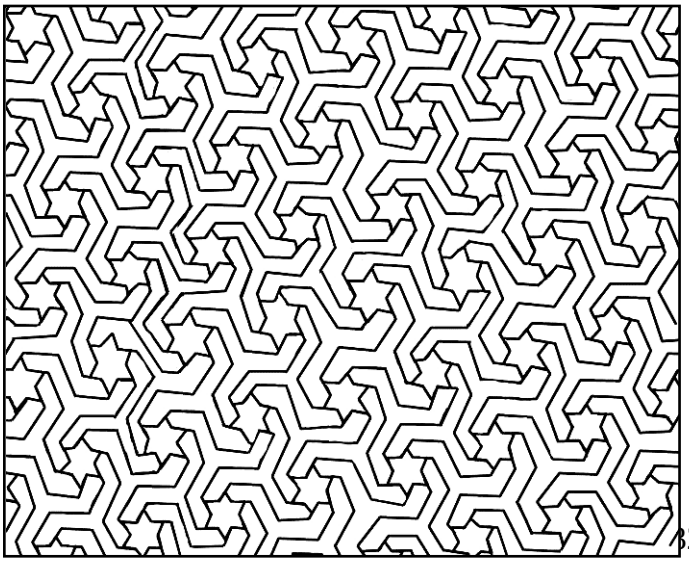




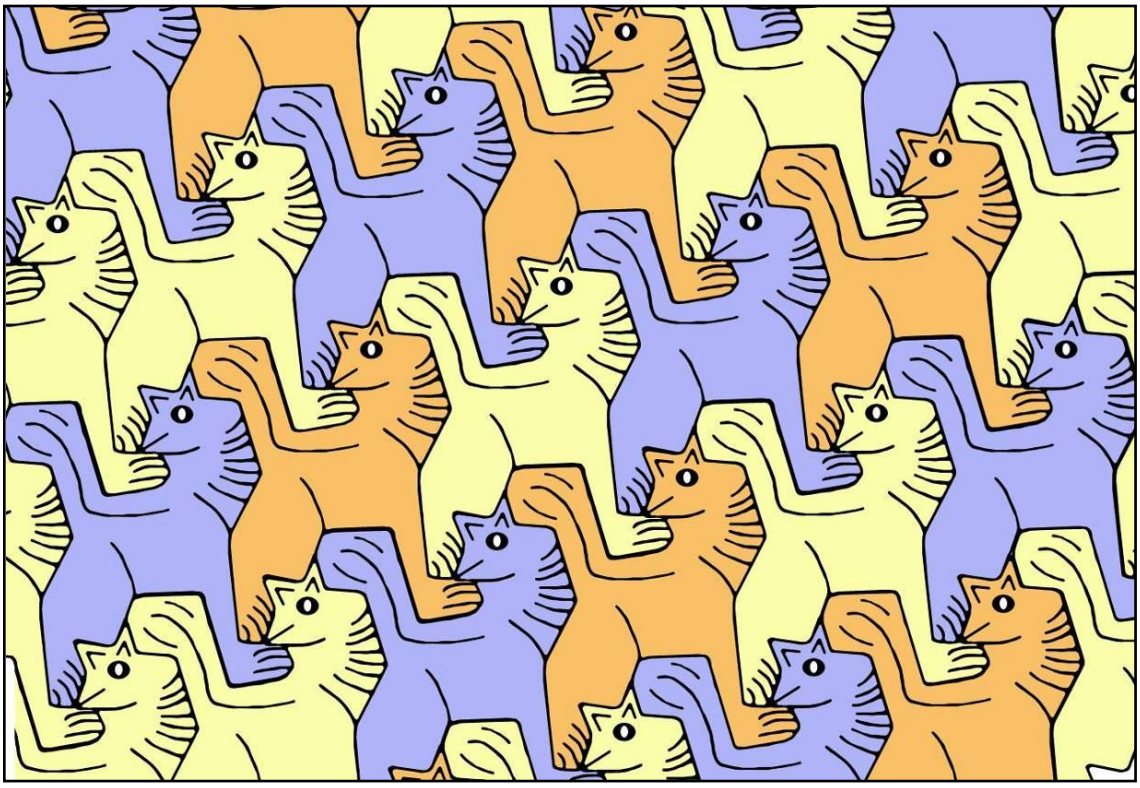
Stuc de la mosquée du Vendredi à Ispahan, XI eme siècle.

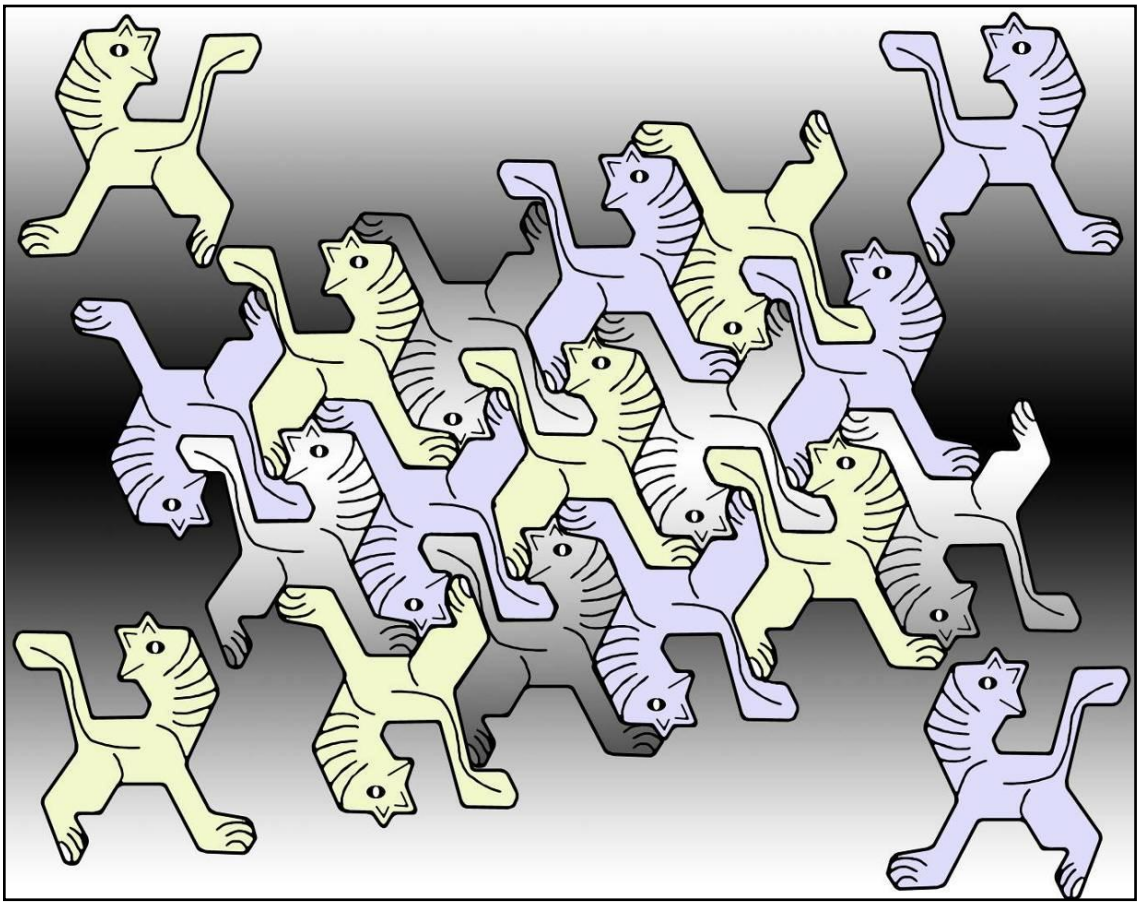


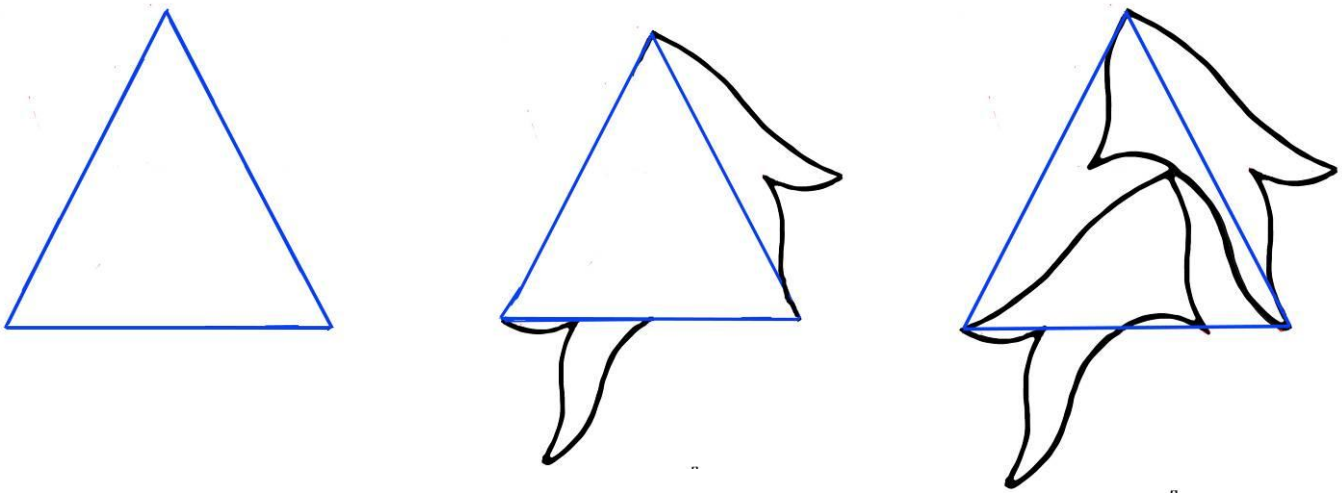




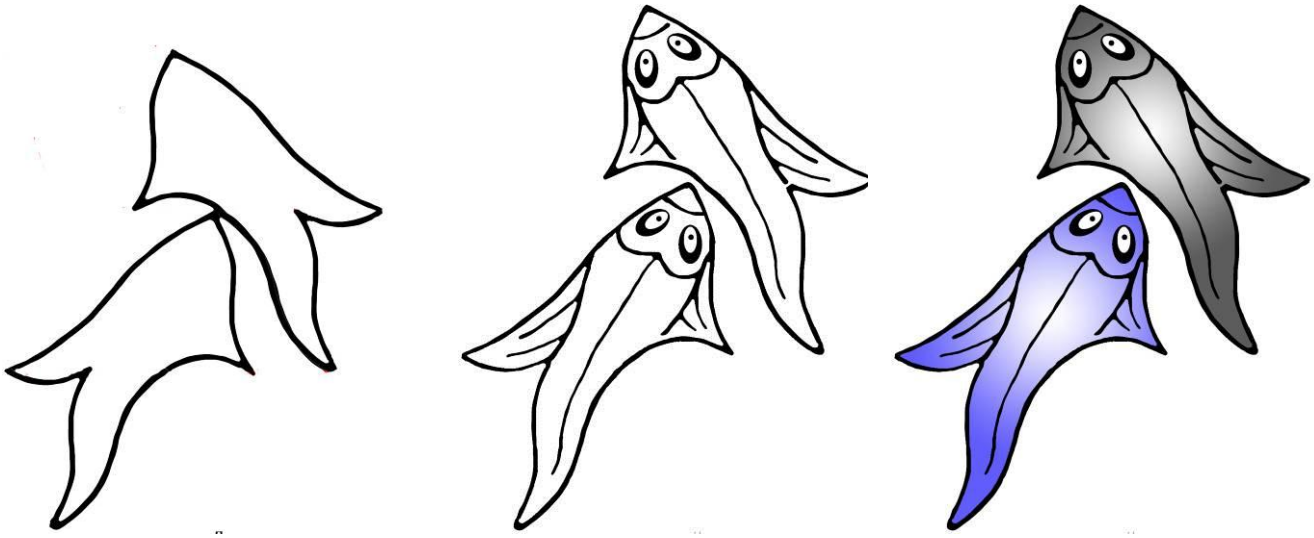
CONSTRUCTION

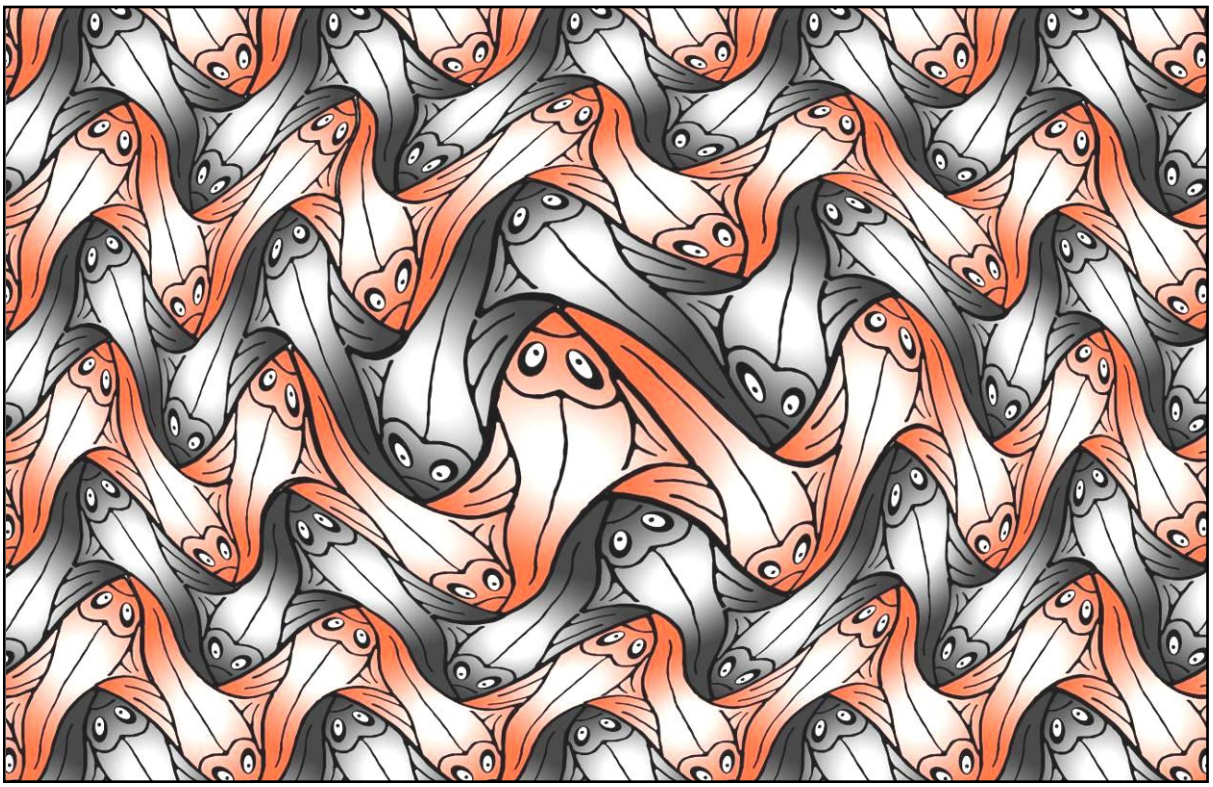


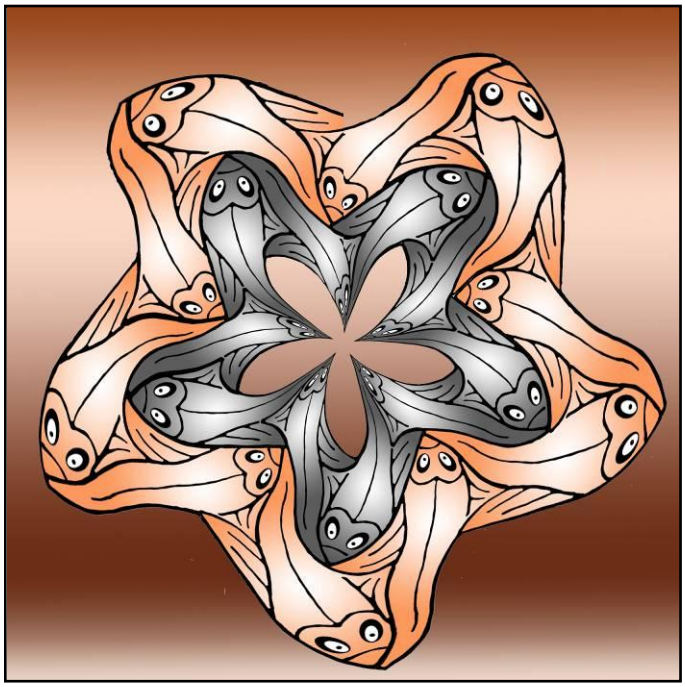


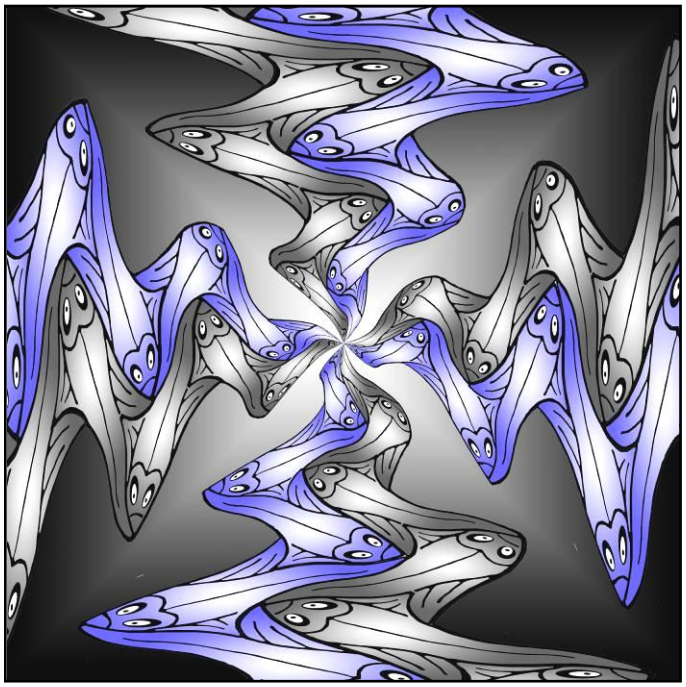


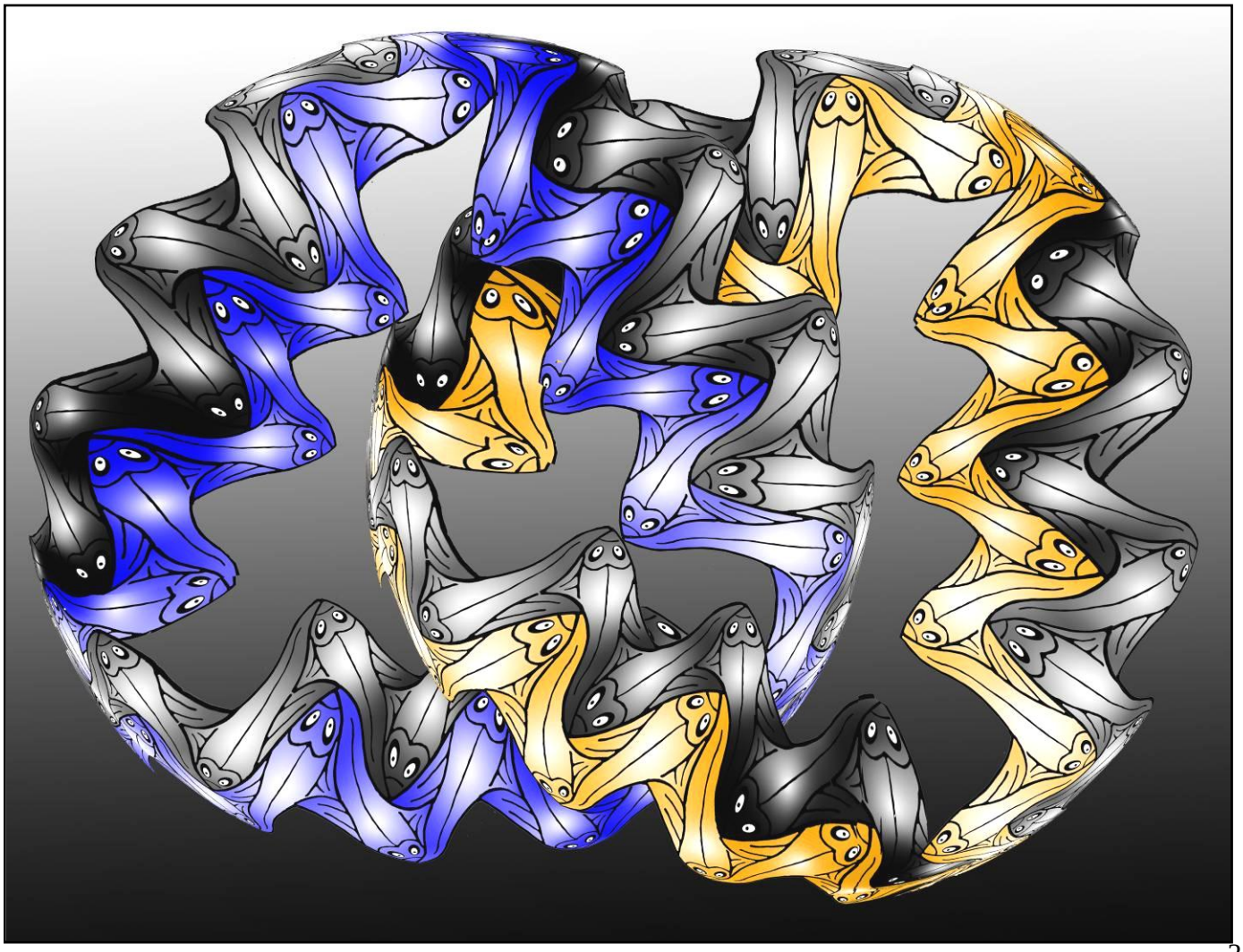
Triangle équilatéral : deux réflexions glissées



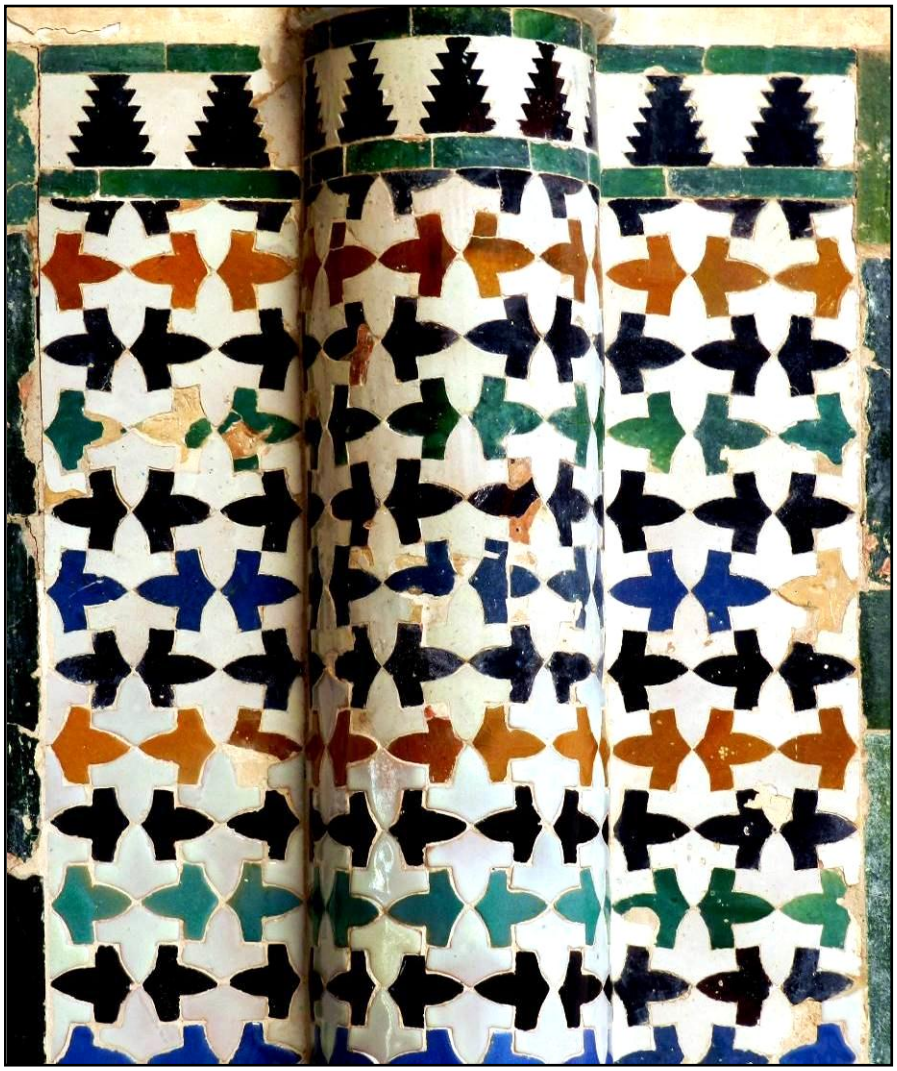


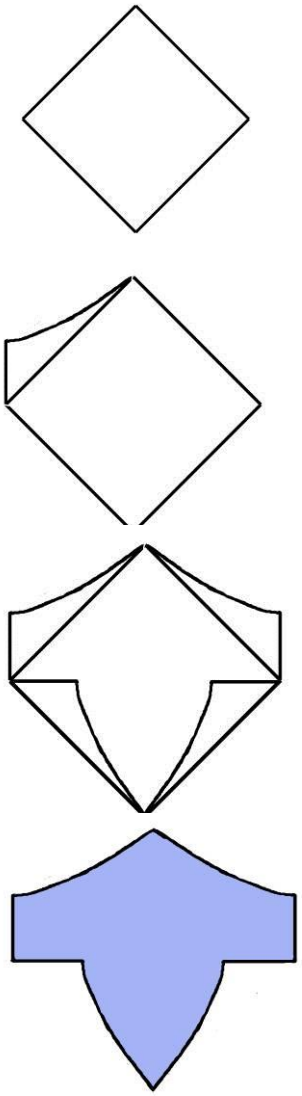




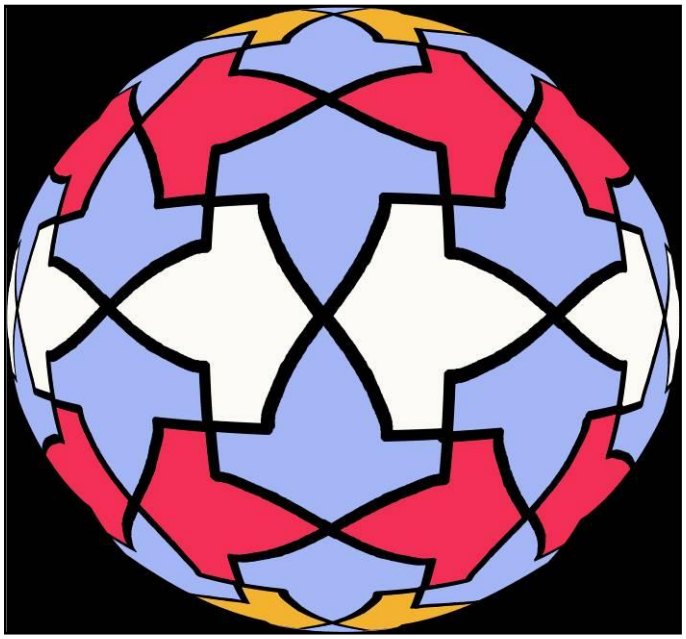


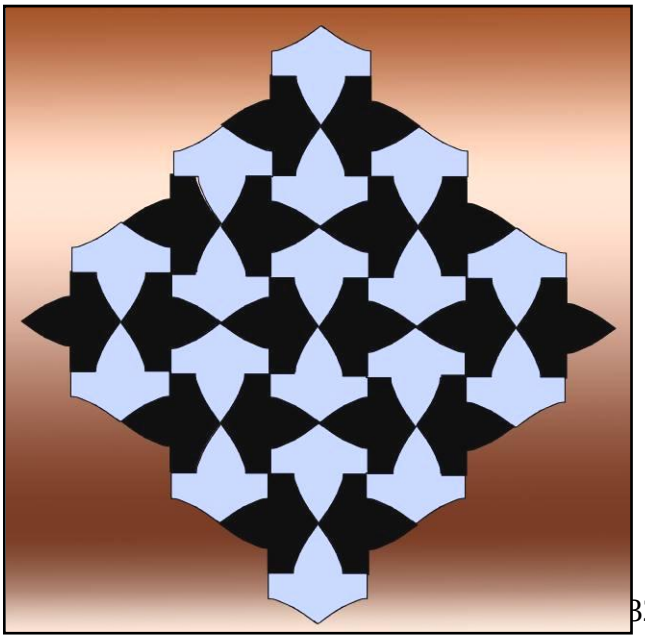
Alhambra de Grenade /

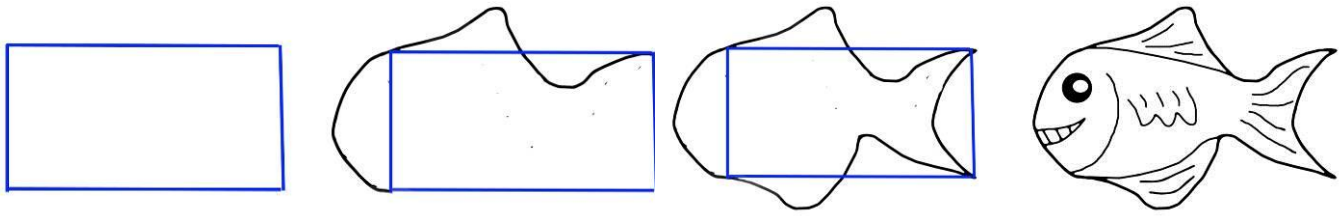




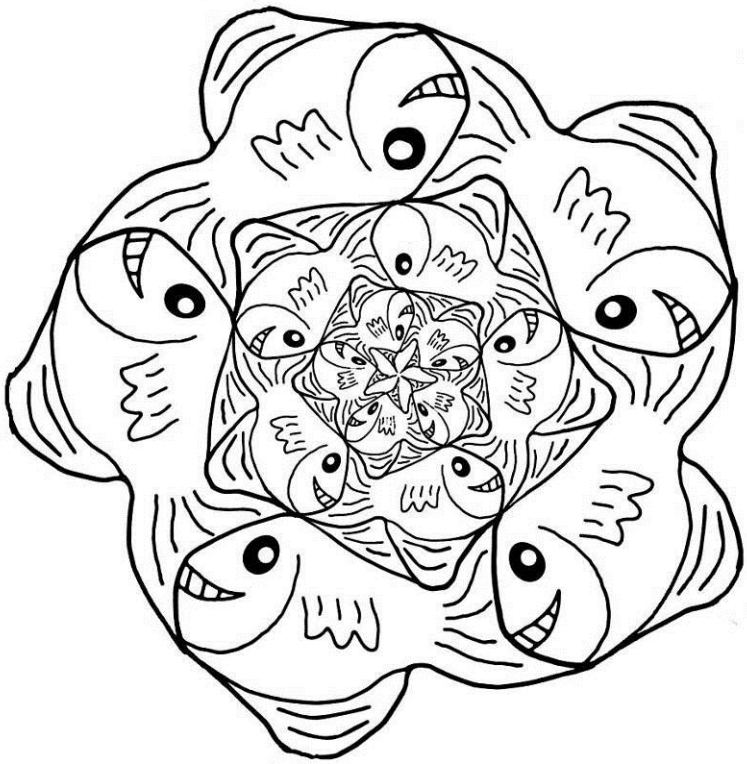
Carré : rotation et réflexion glissée.

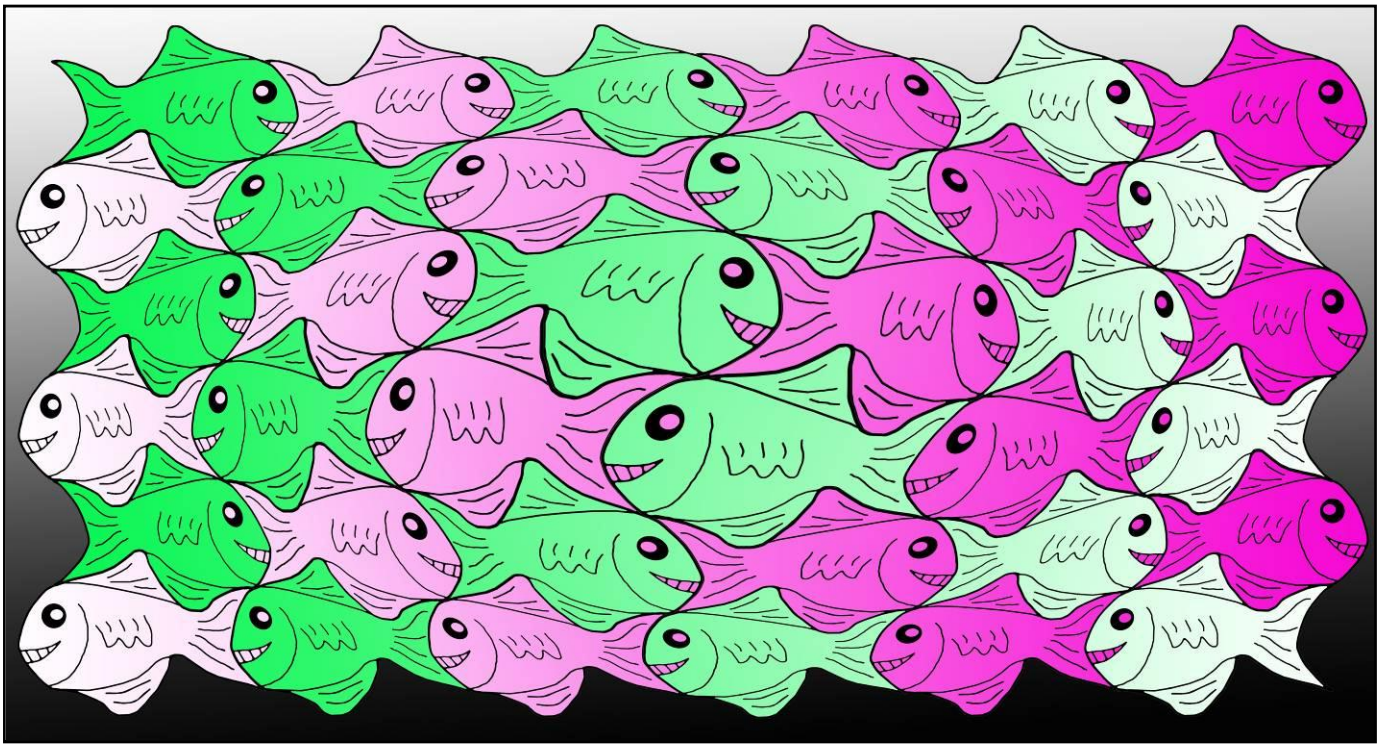


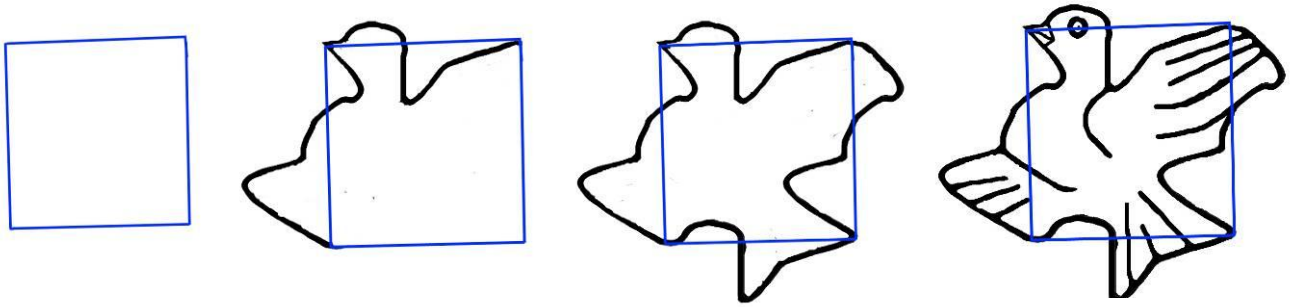




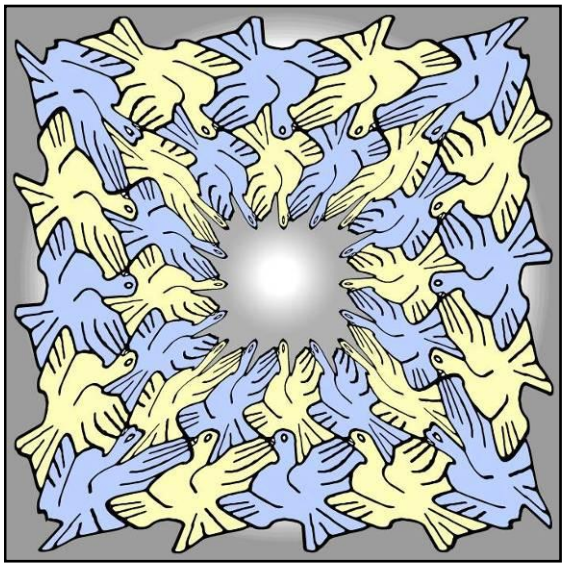
Rectangle : une translation et une réflexion glissée

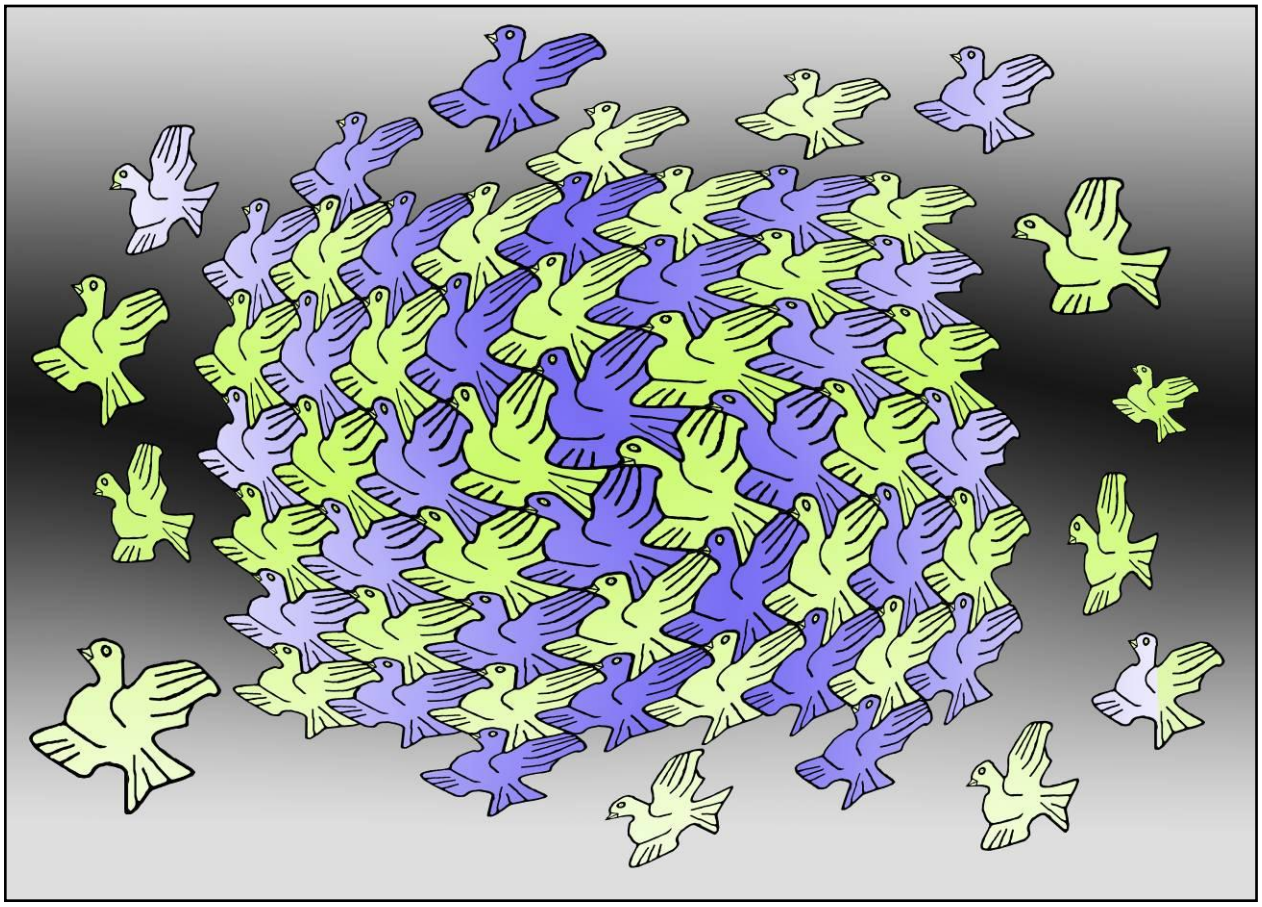




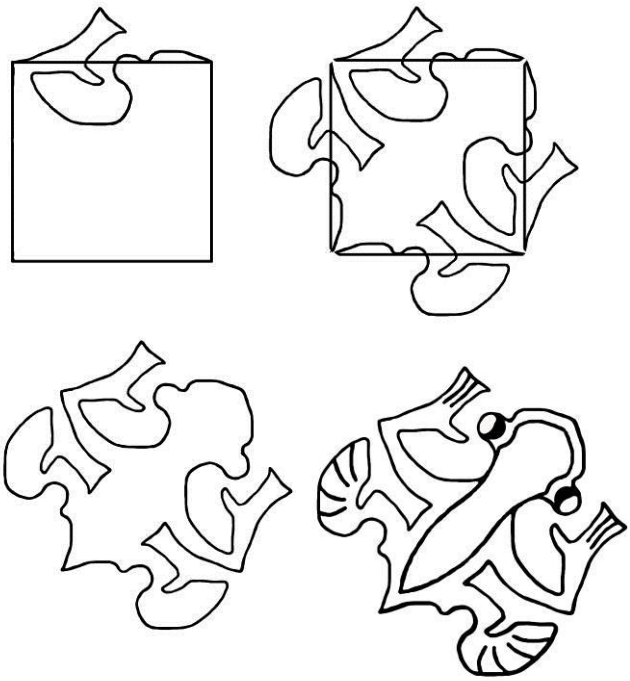


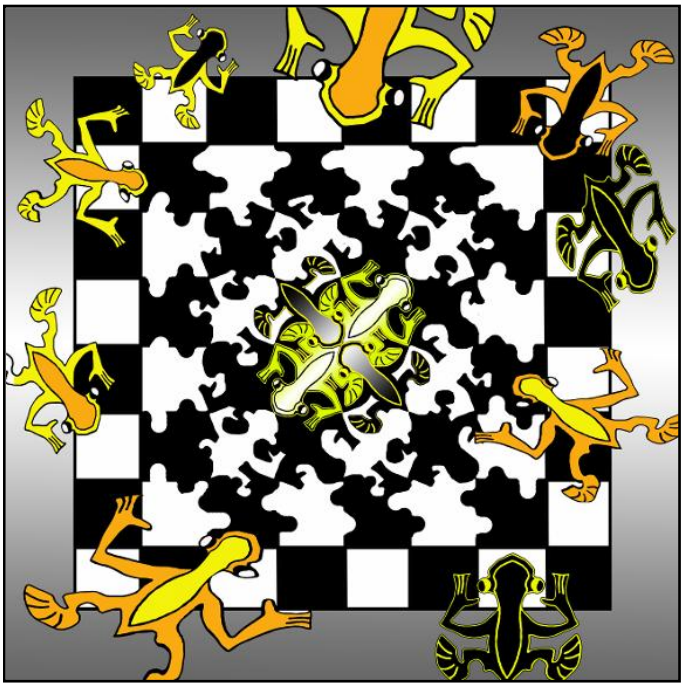
Carré : une translation et une réflexion glissée.

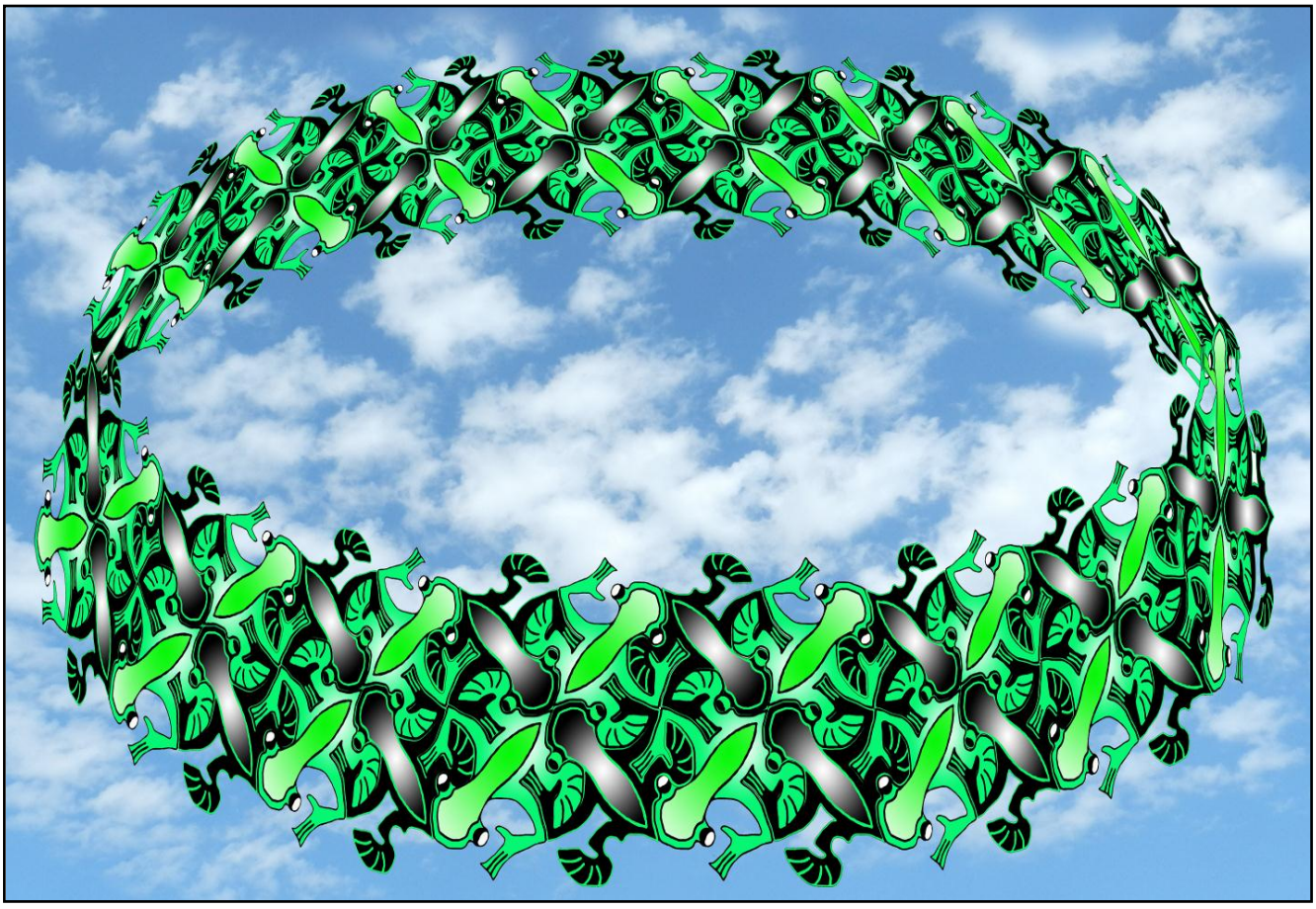


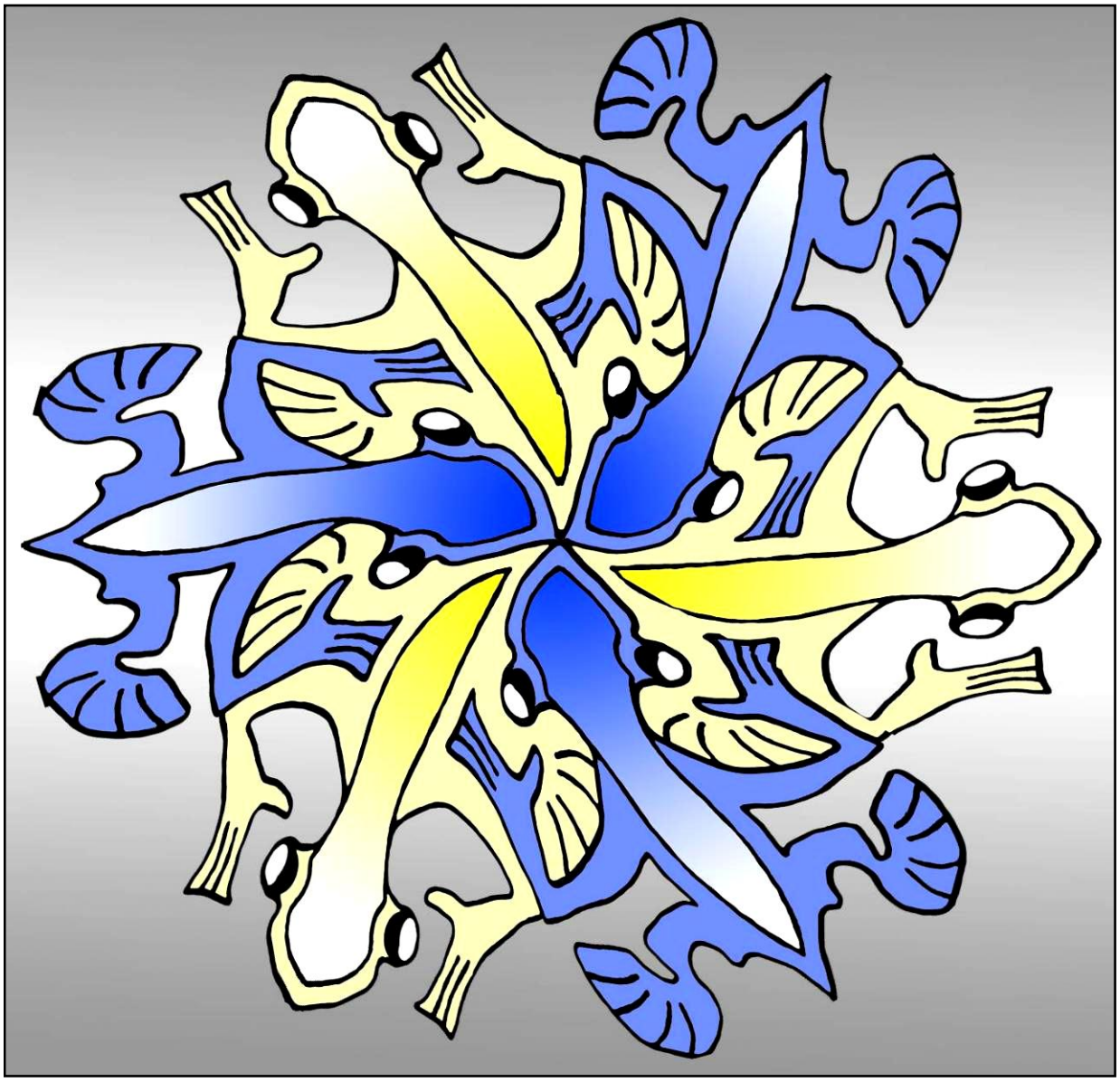


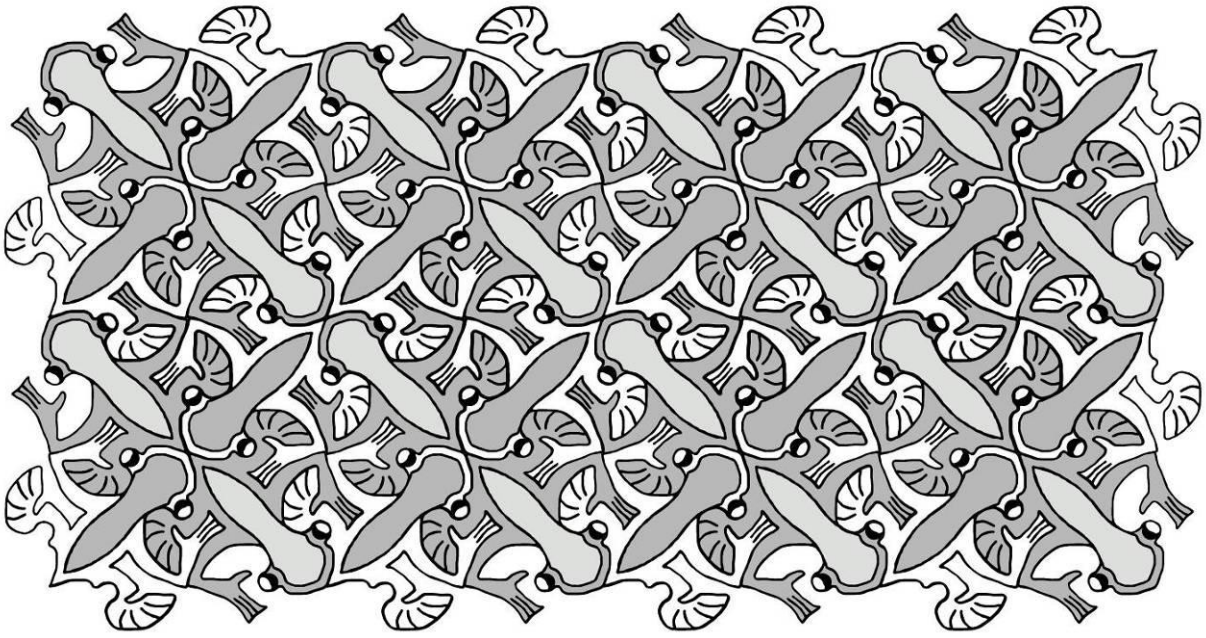
CONSTRUCTION

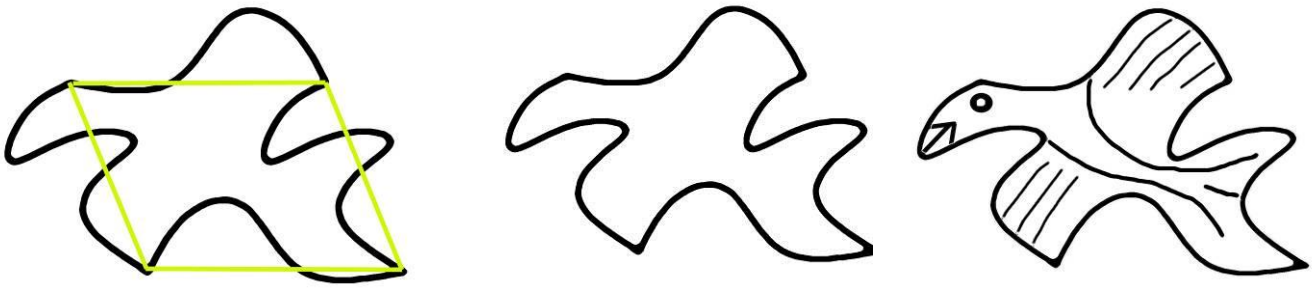




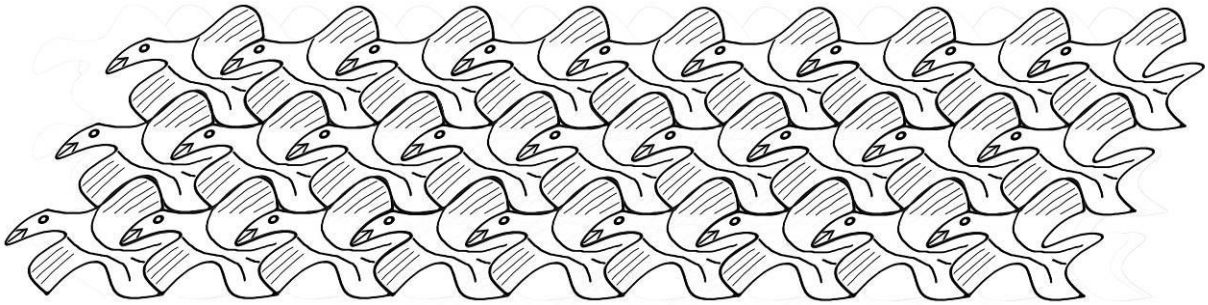


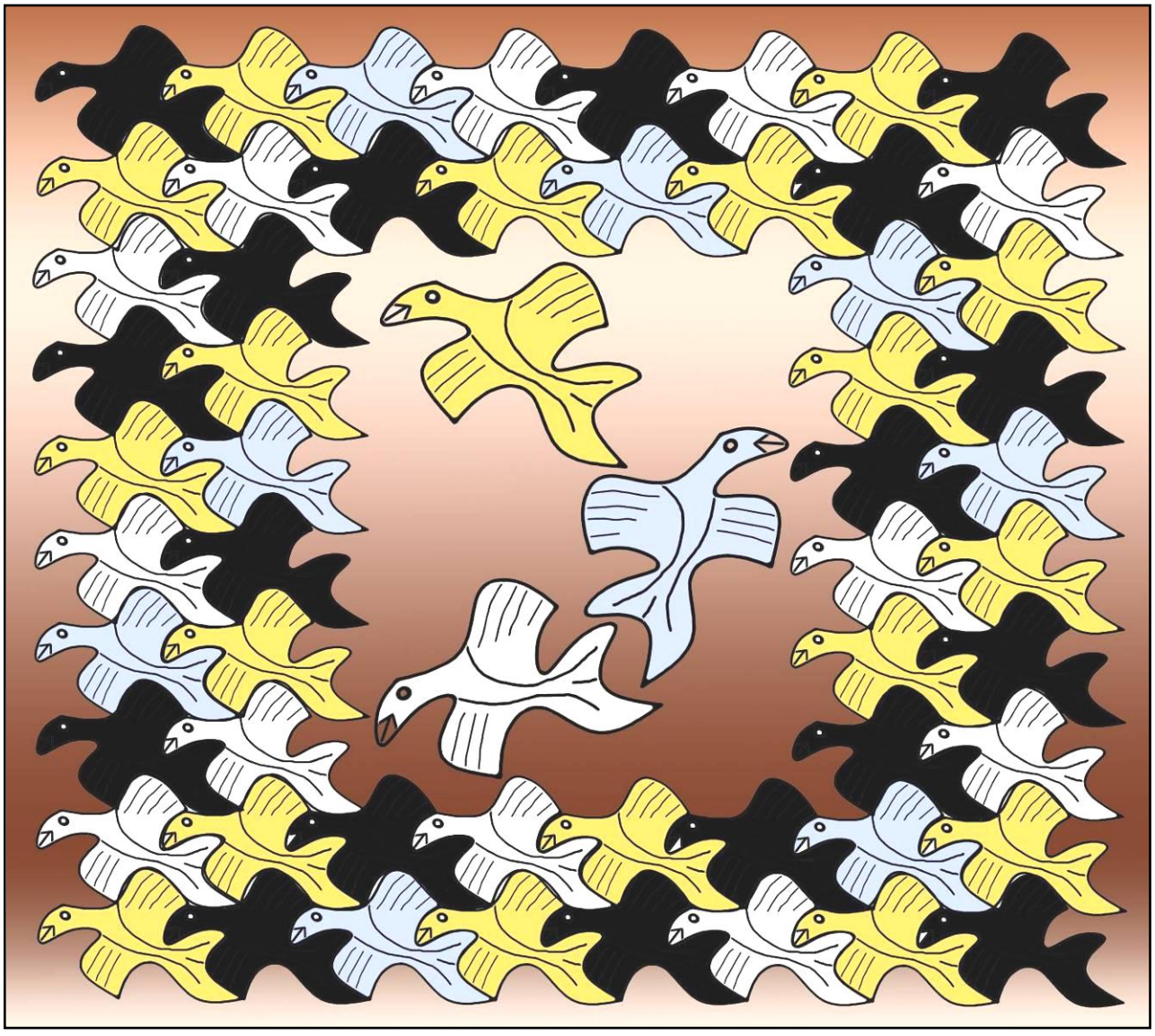




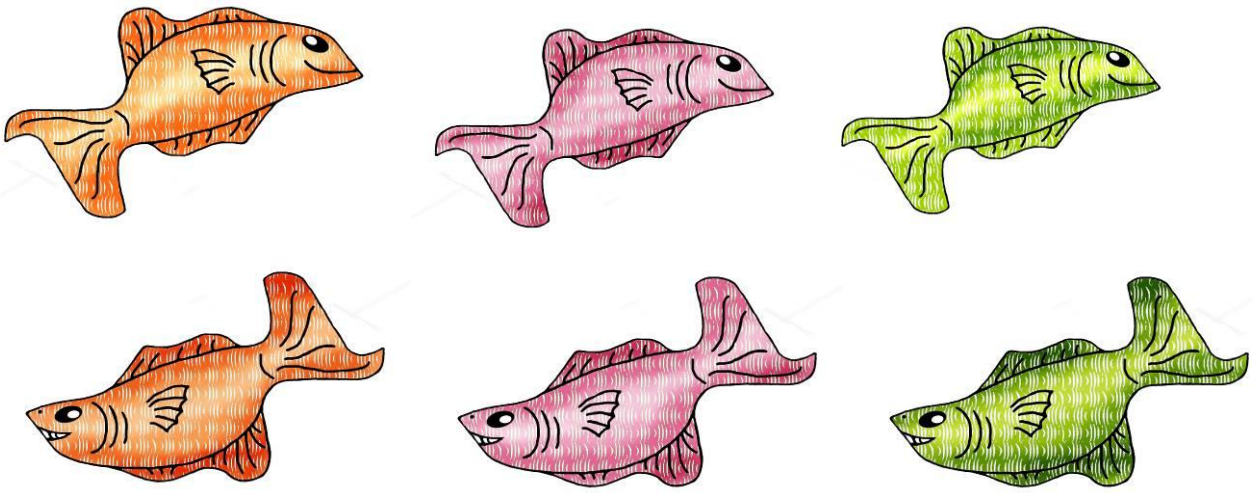


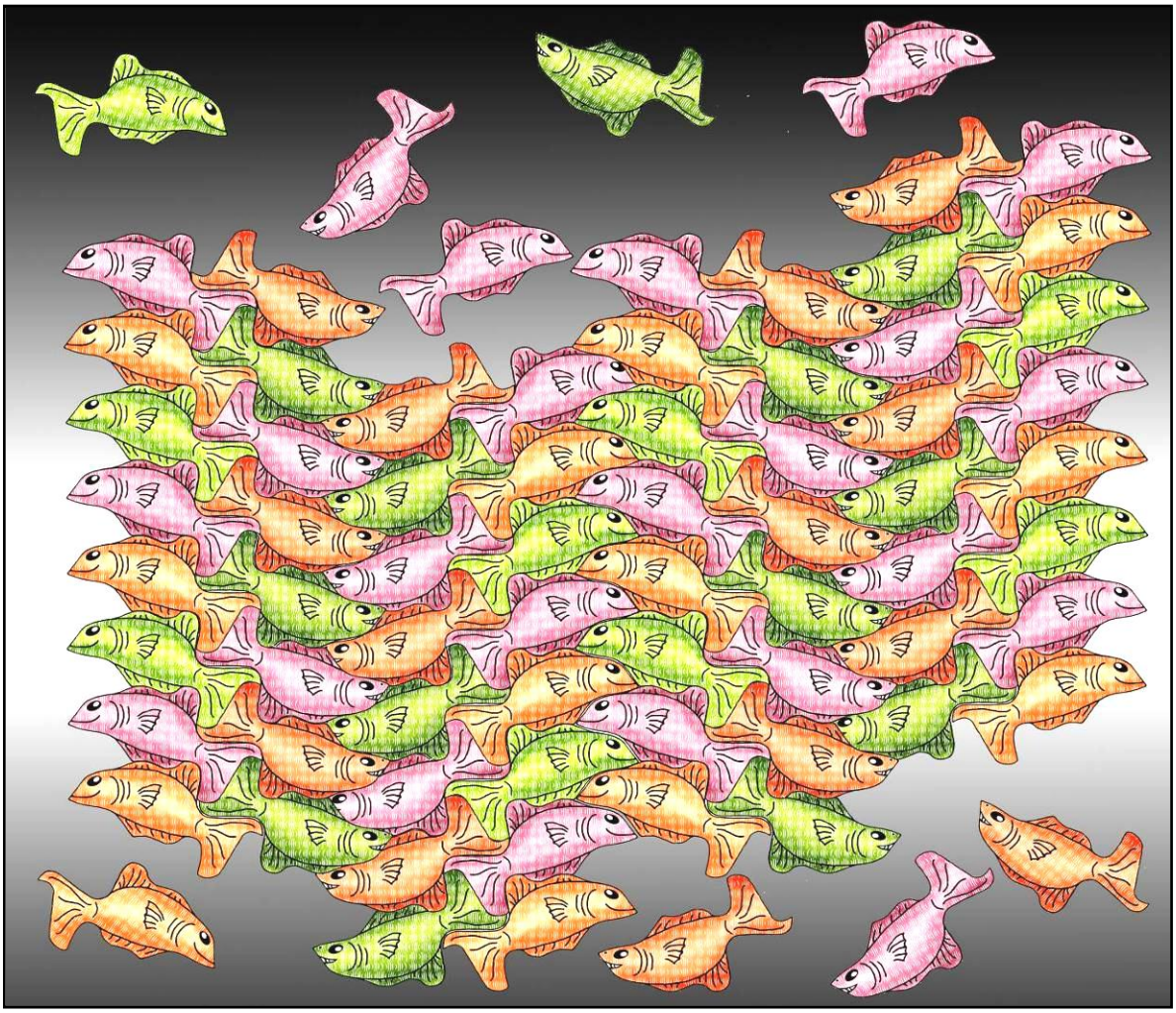
Parallélogramme : une translation et une réflexion glissée.

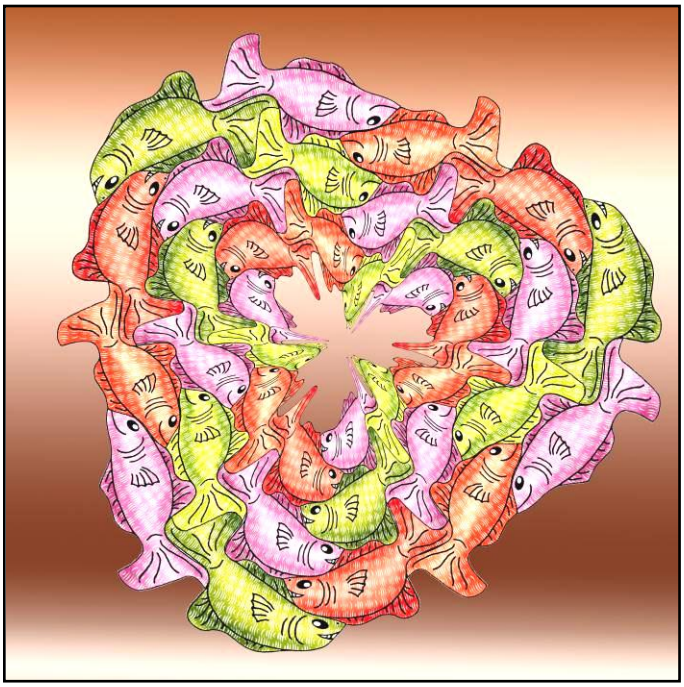


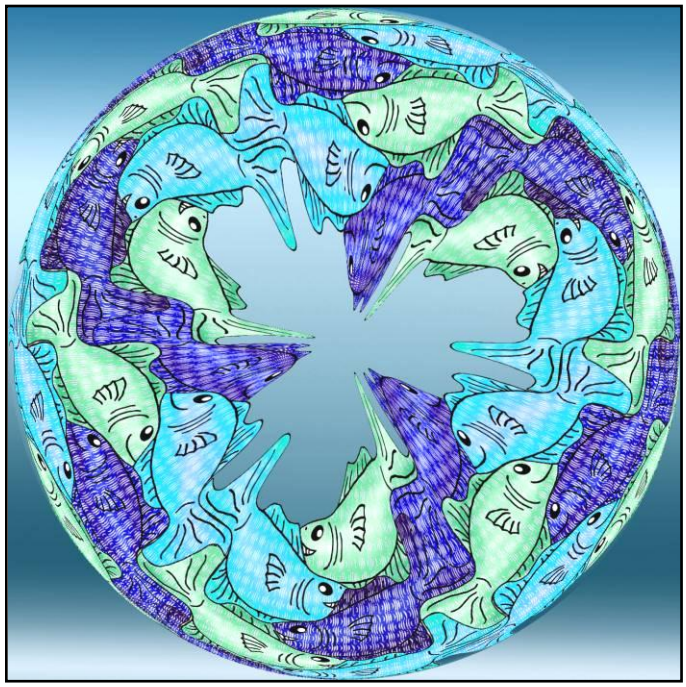


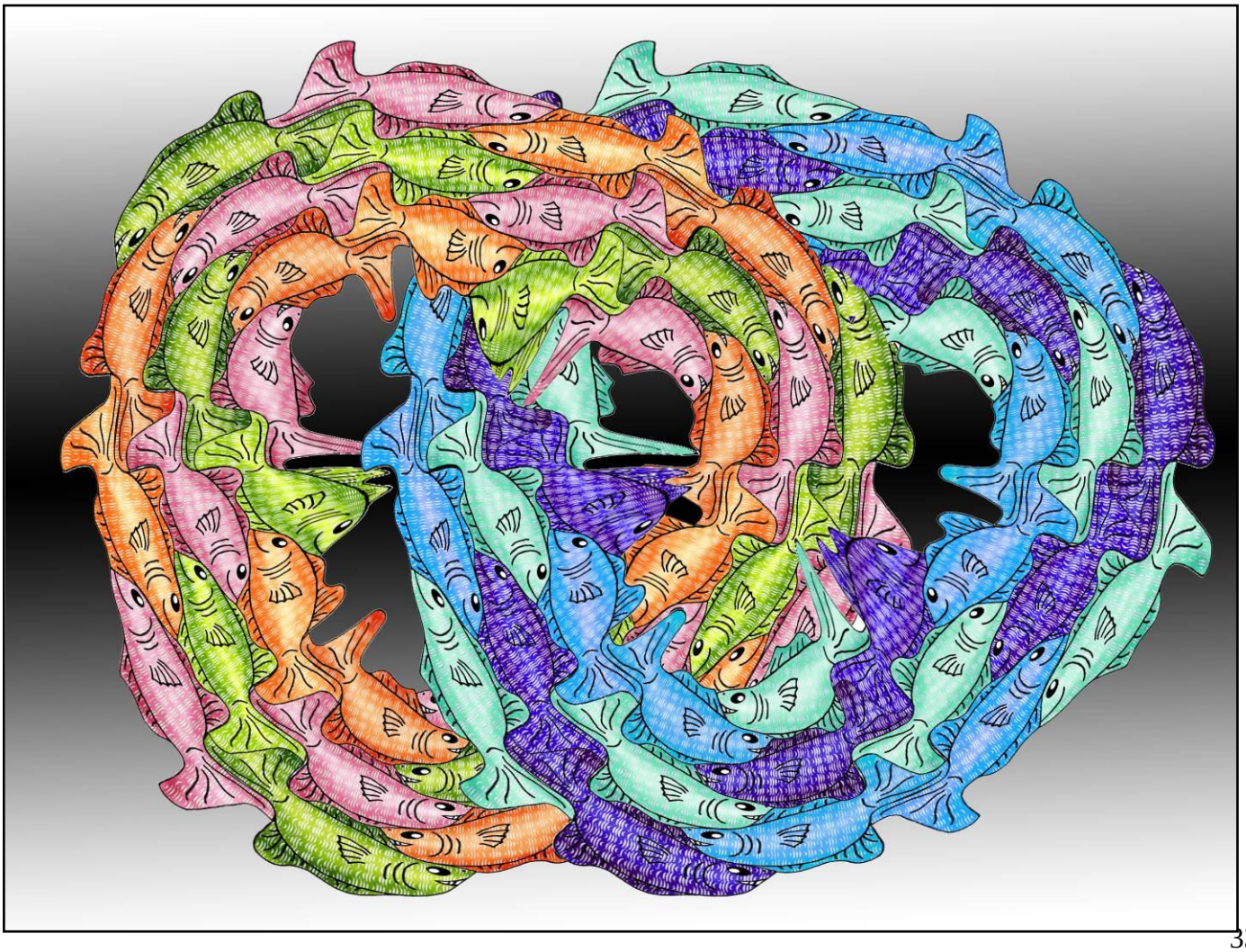
Octogone : deux symétries centrales, deux translations, une rotation.

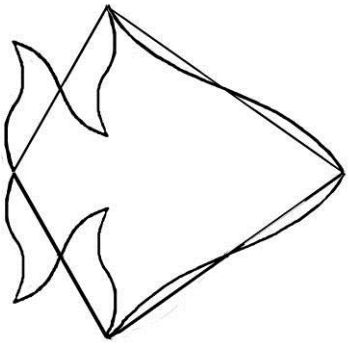
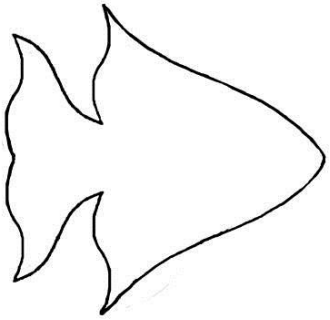
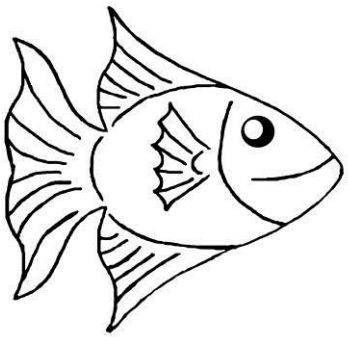






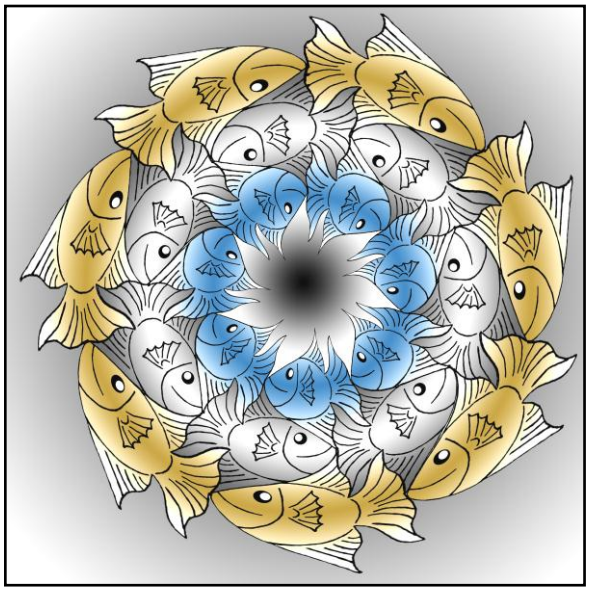
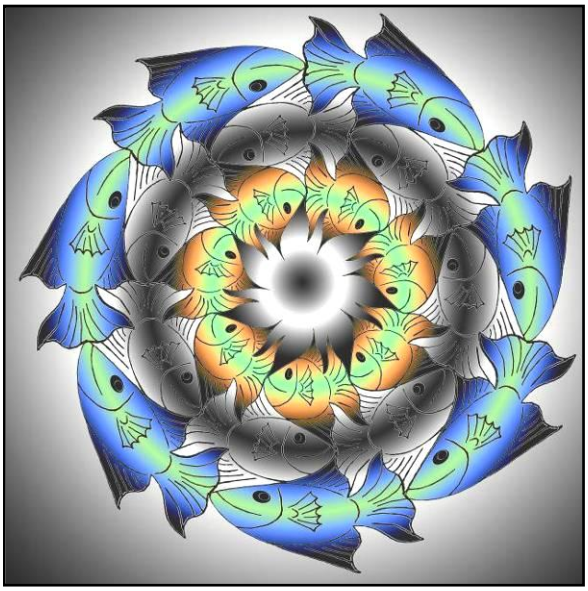
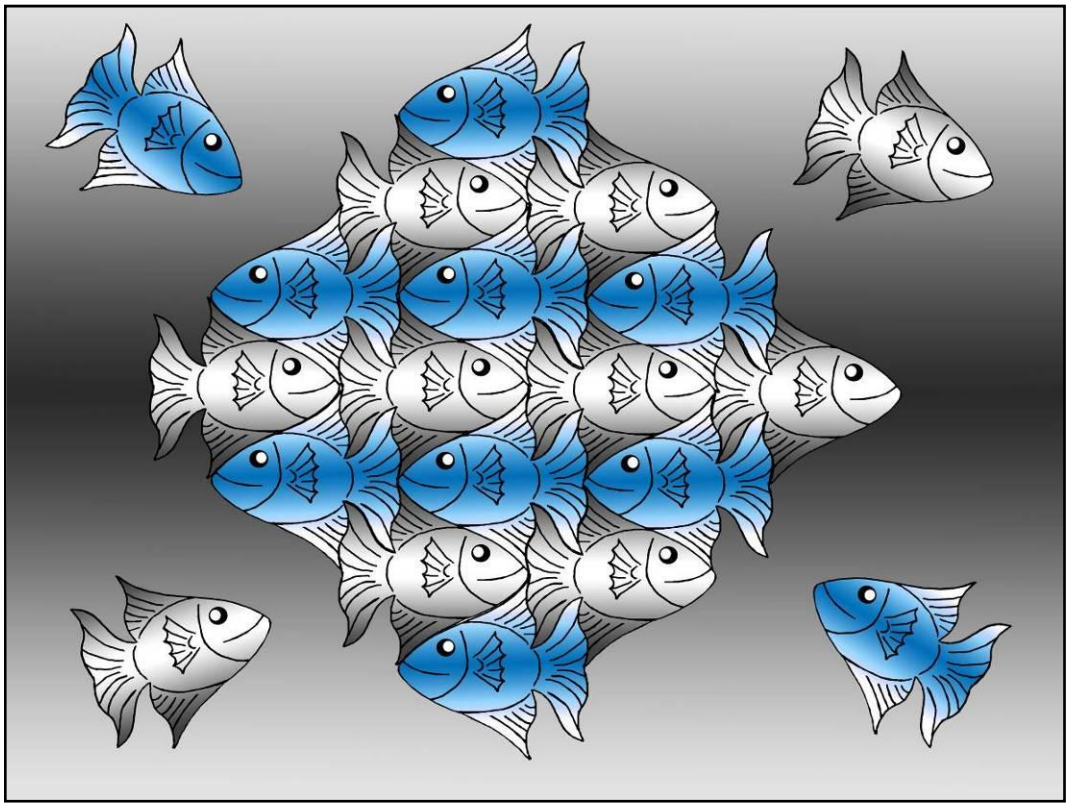


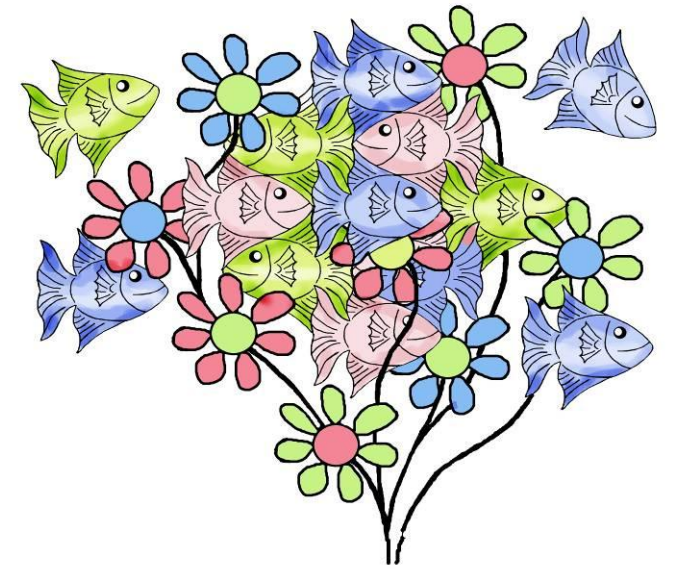


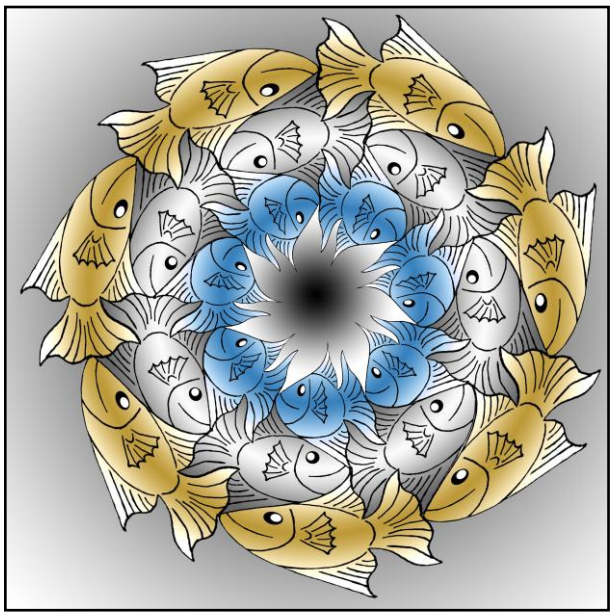




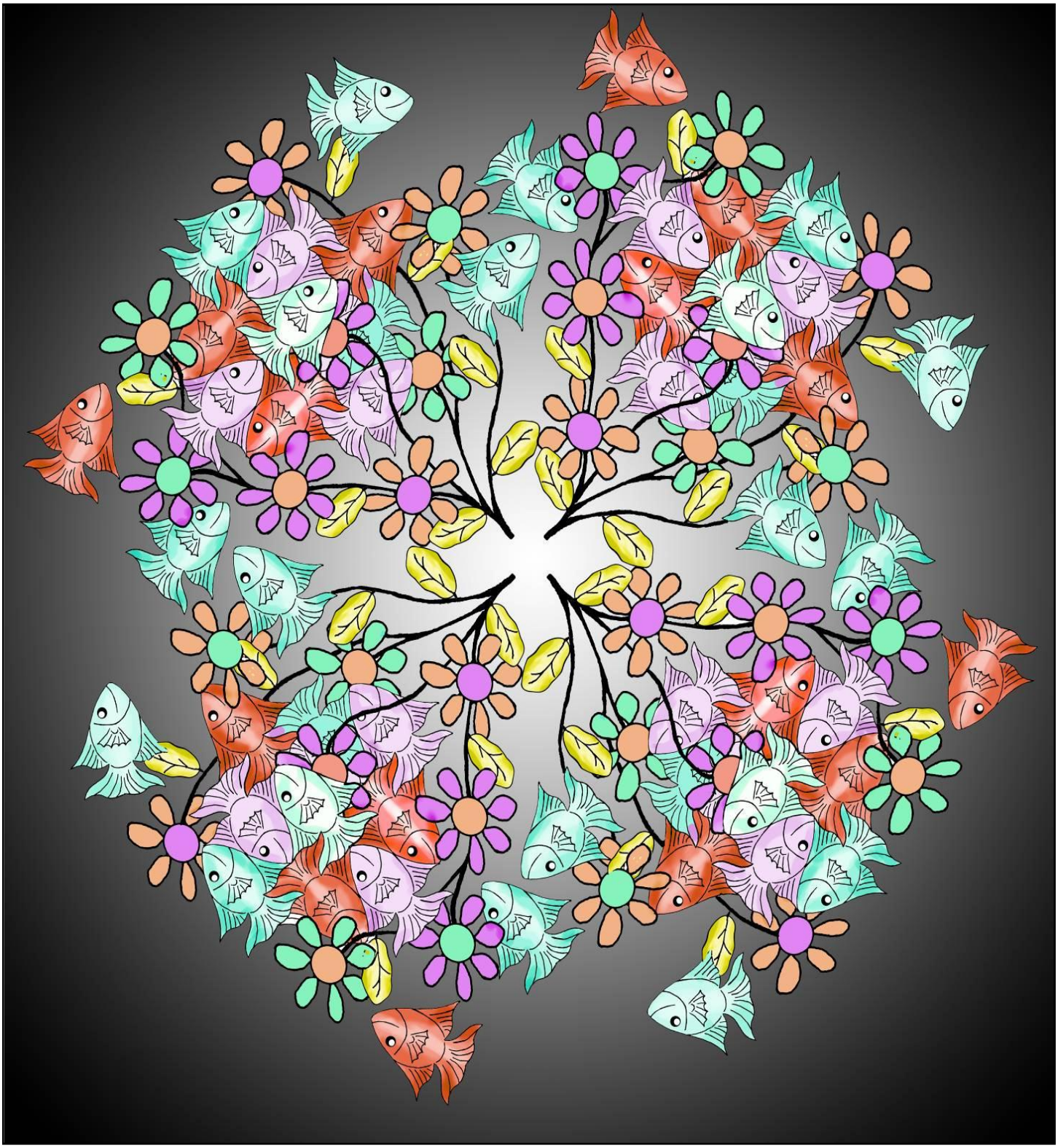
CONSTRUCTION

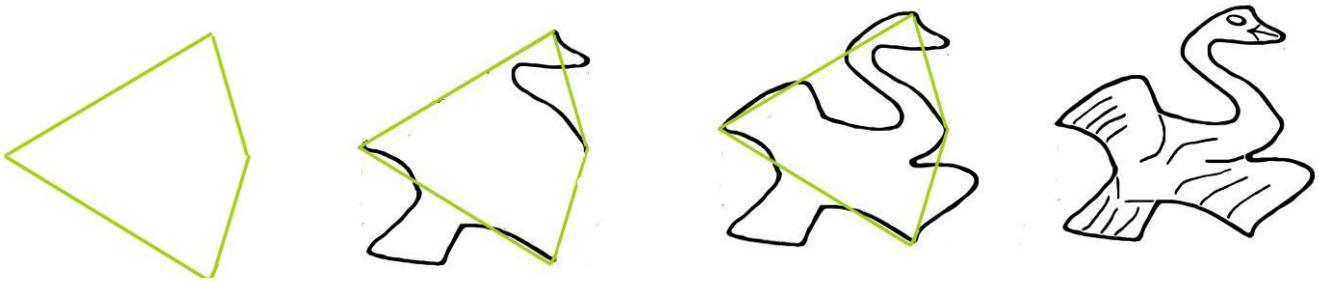
Quadrilatère convexe : deux symétries centrales et un symétrie axiale.



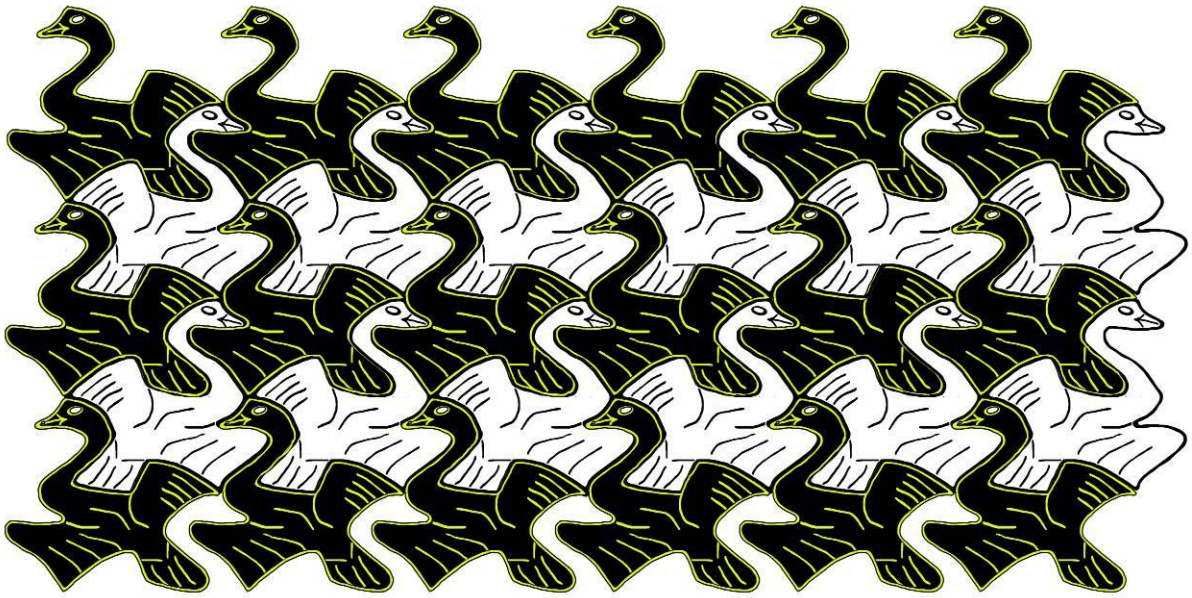


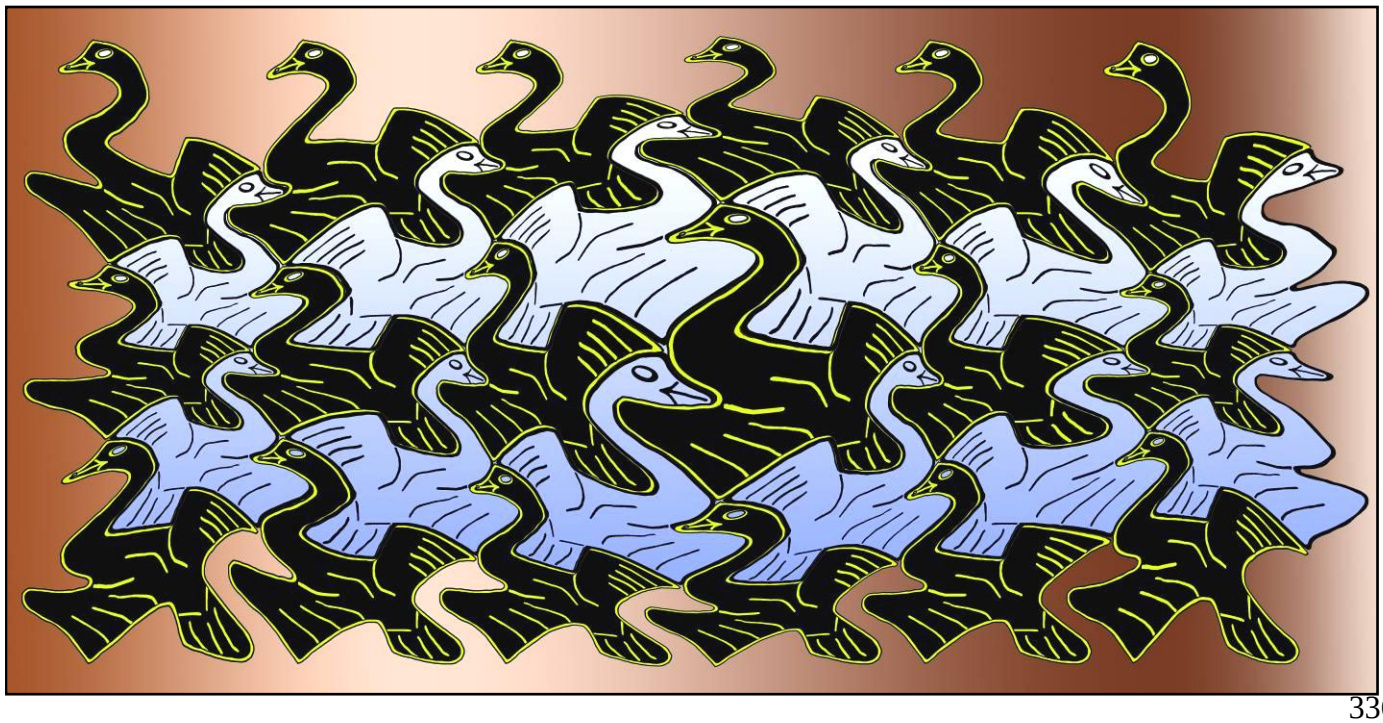


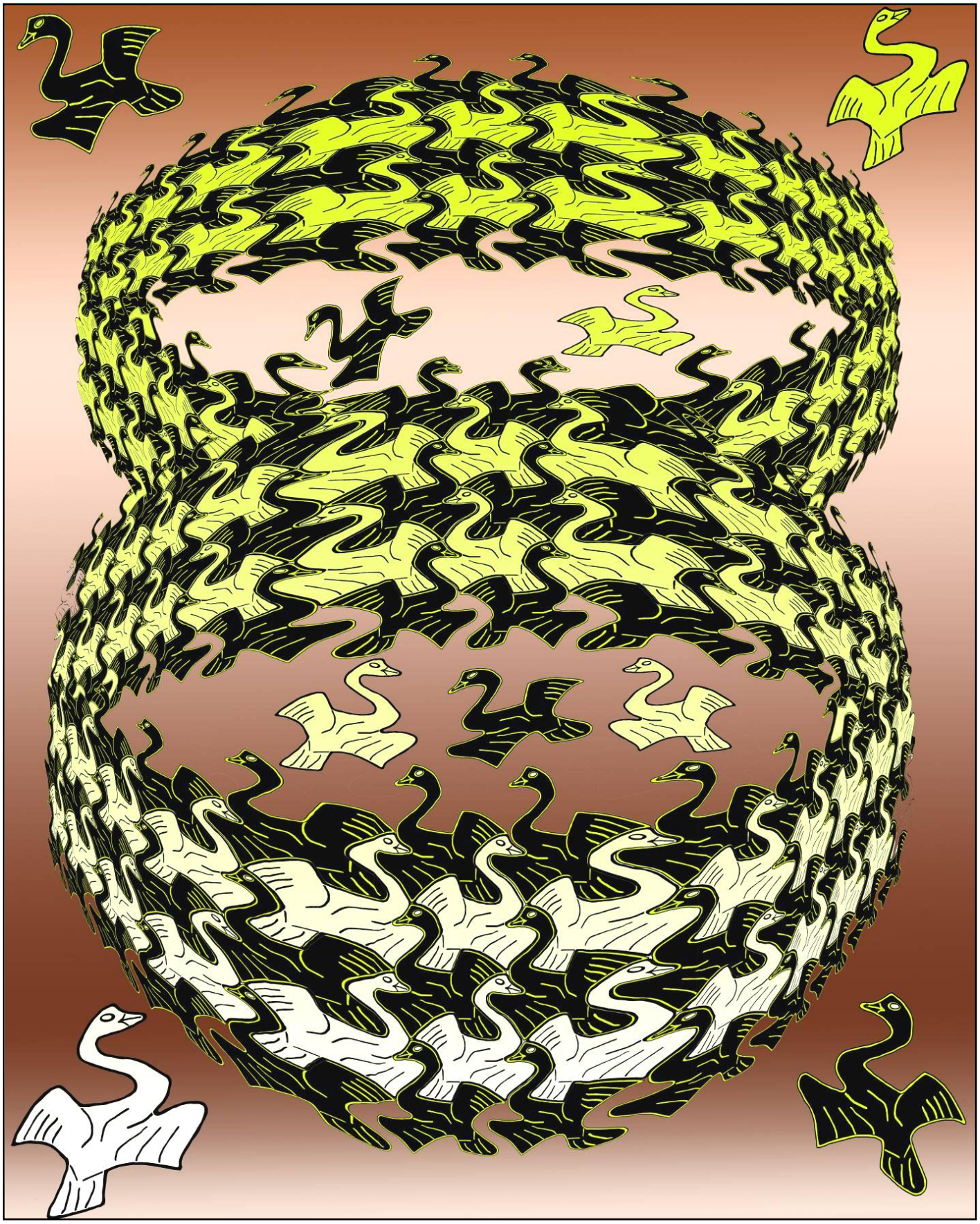


Quadrilatère ; deux rotations.

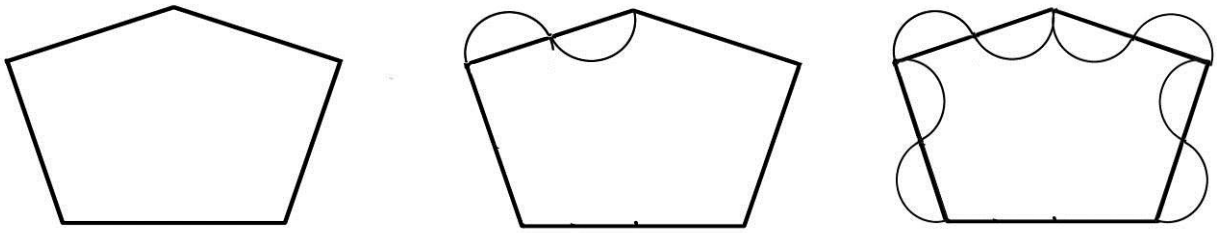
CONSTRUCTION



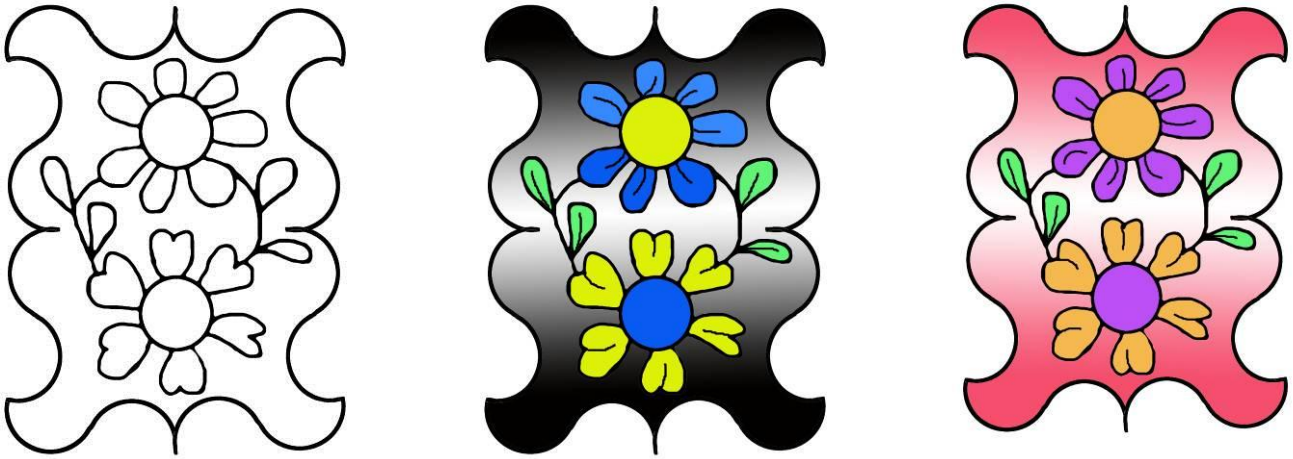


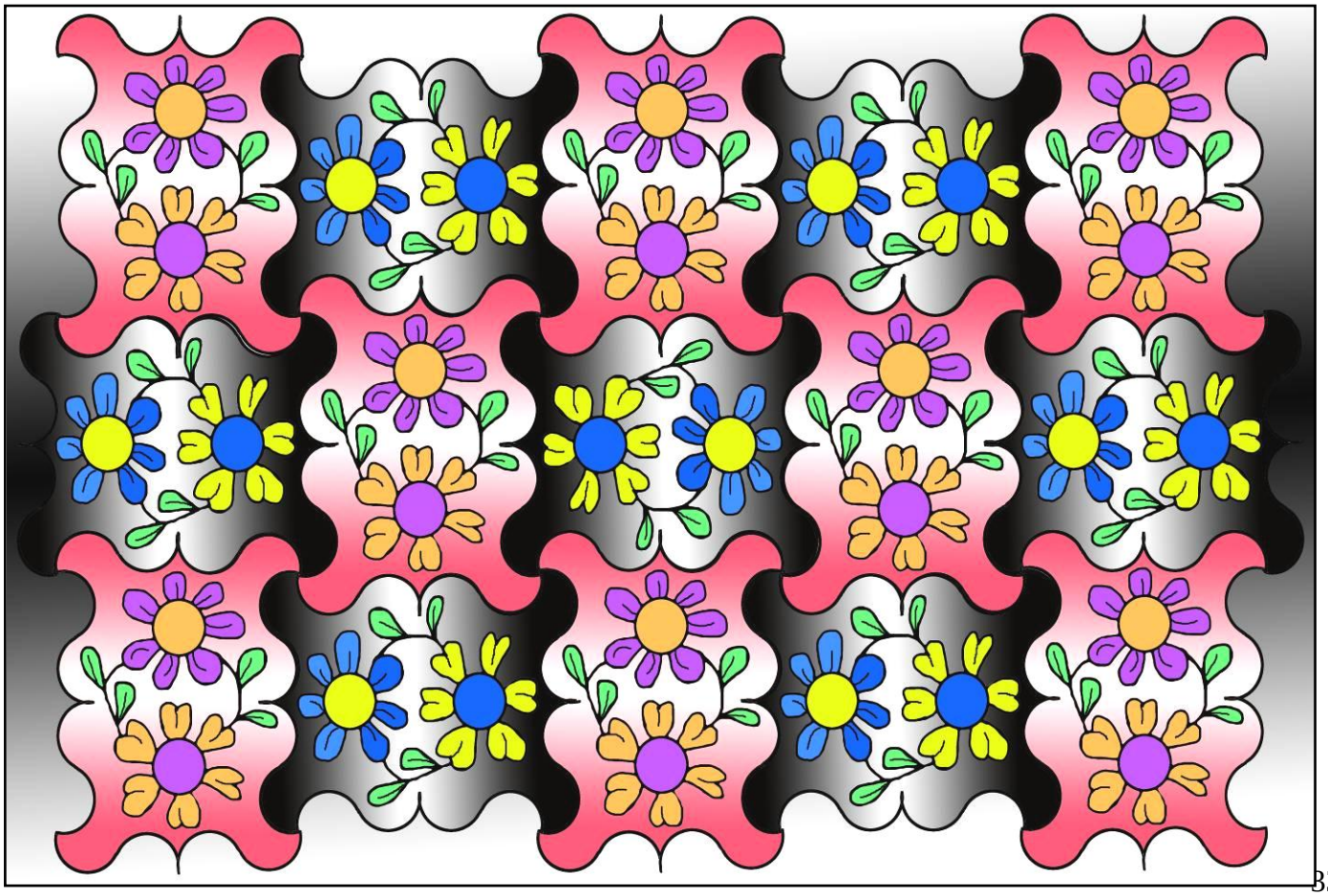


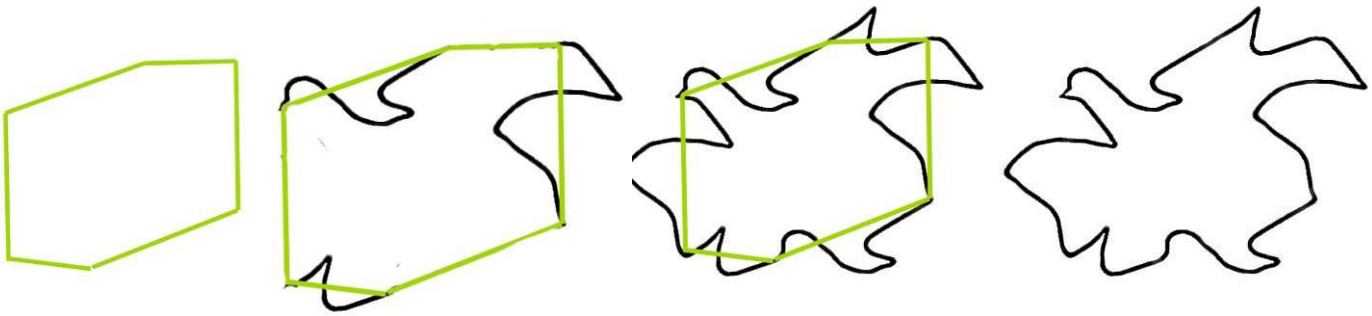
c) Les polygones : les pentagones :



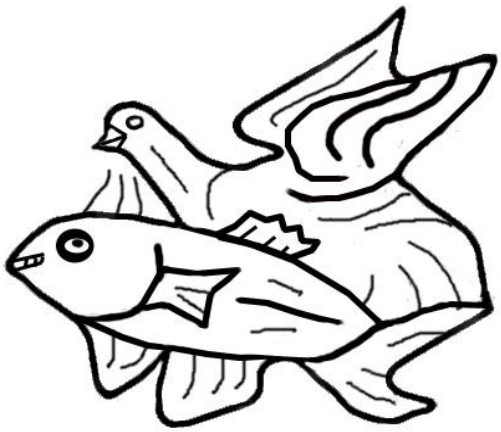
Pavage du Caire : pentagone ; une rotation suivie d'une symétrie axiale et deux rotations.

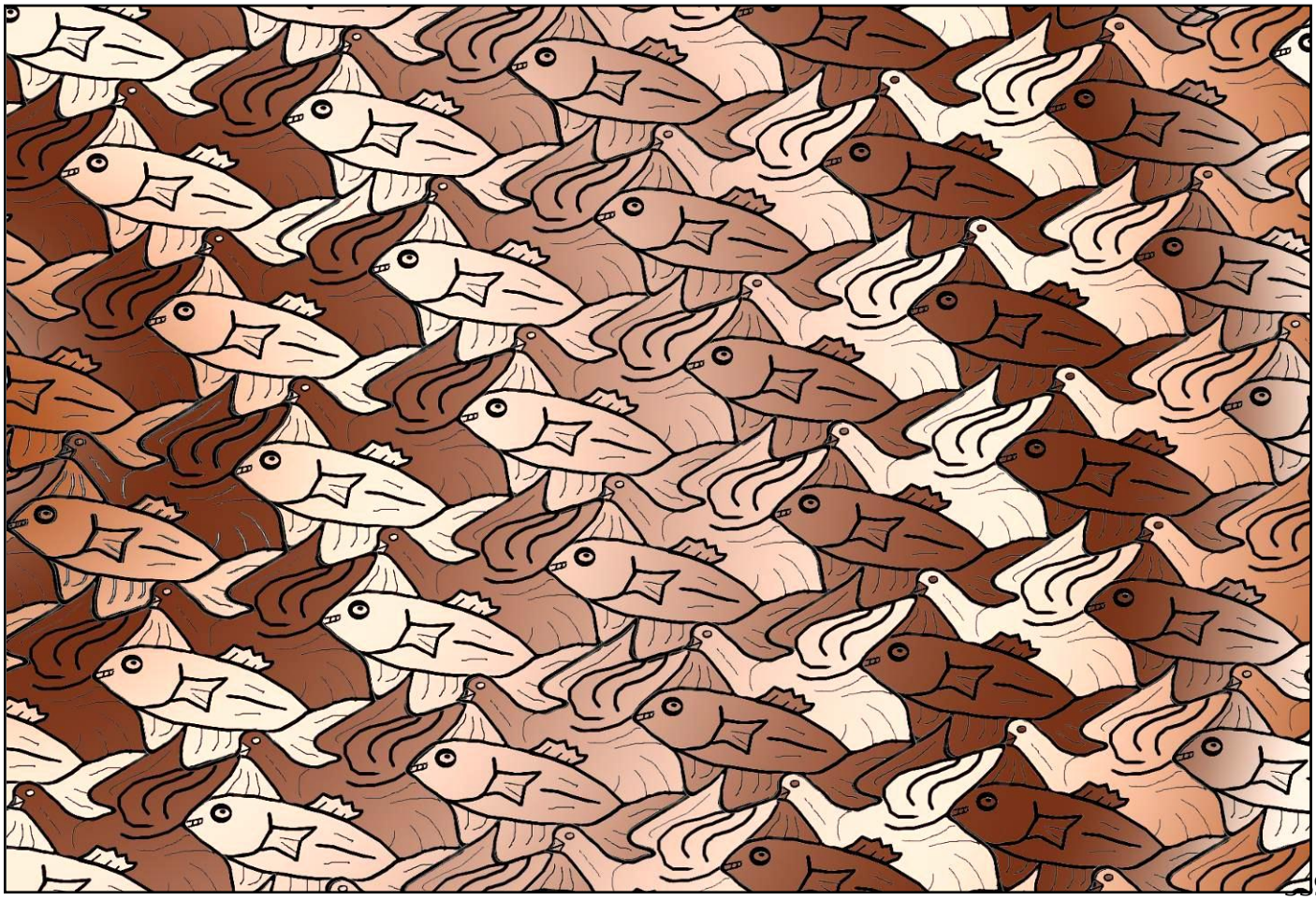


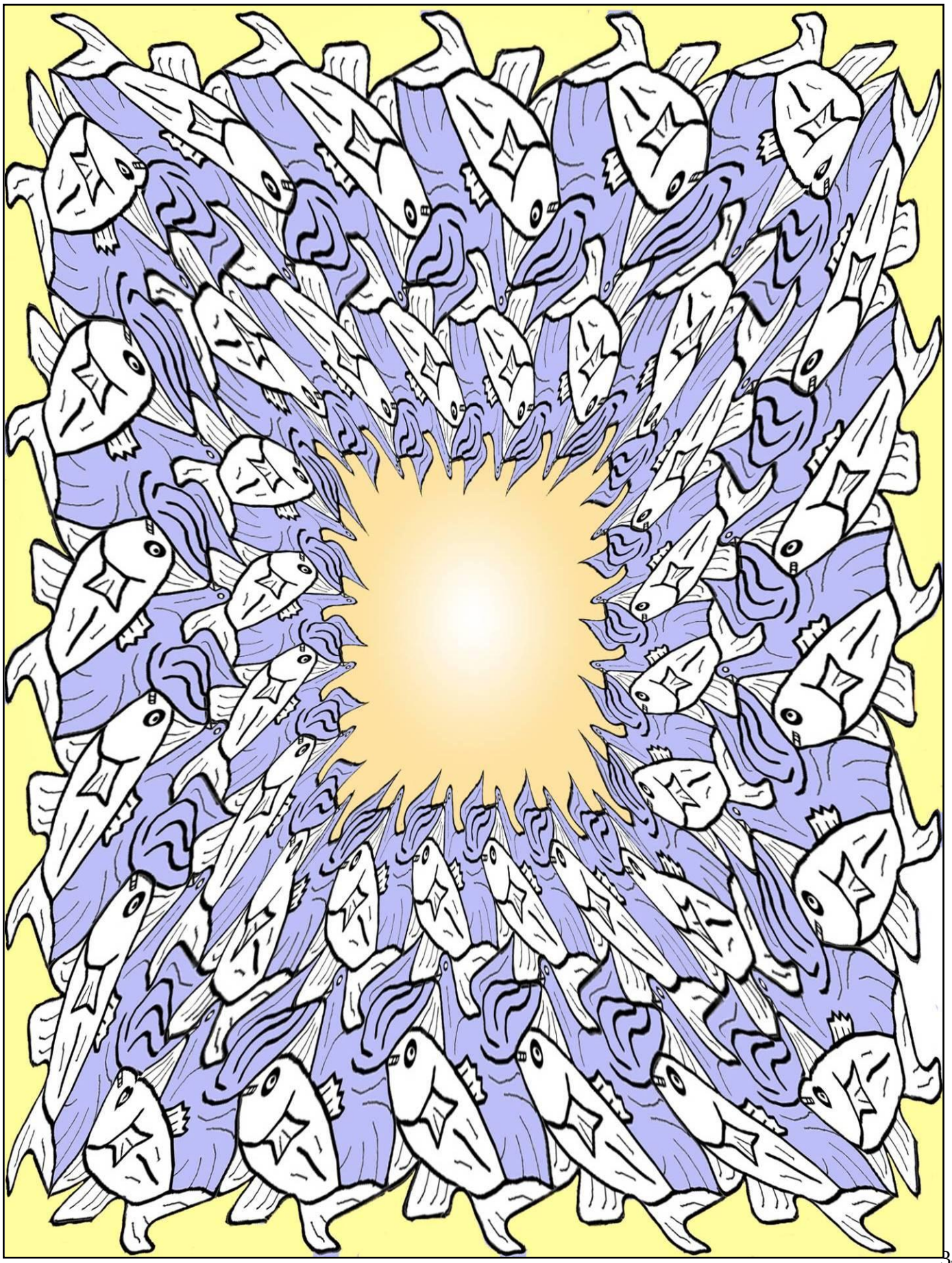


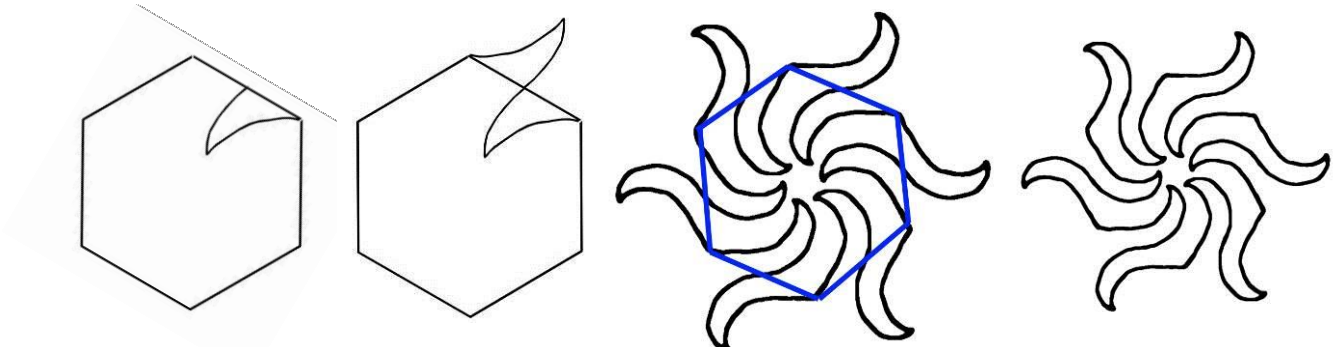


Hexagone : trois translations

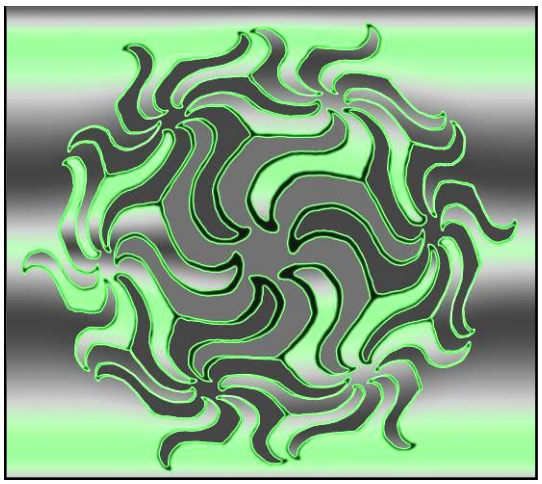


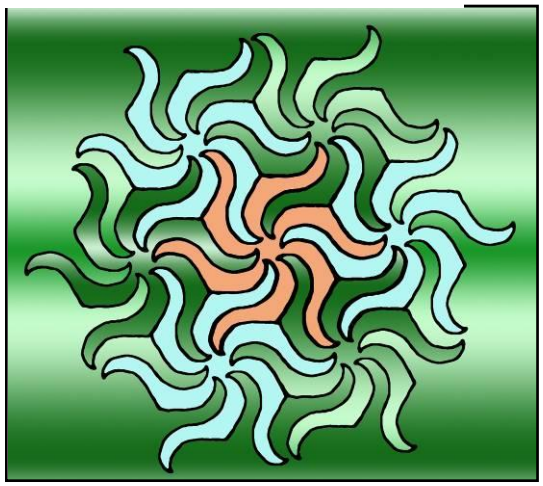


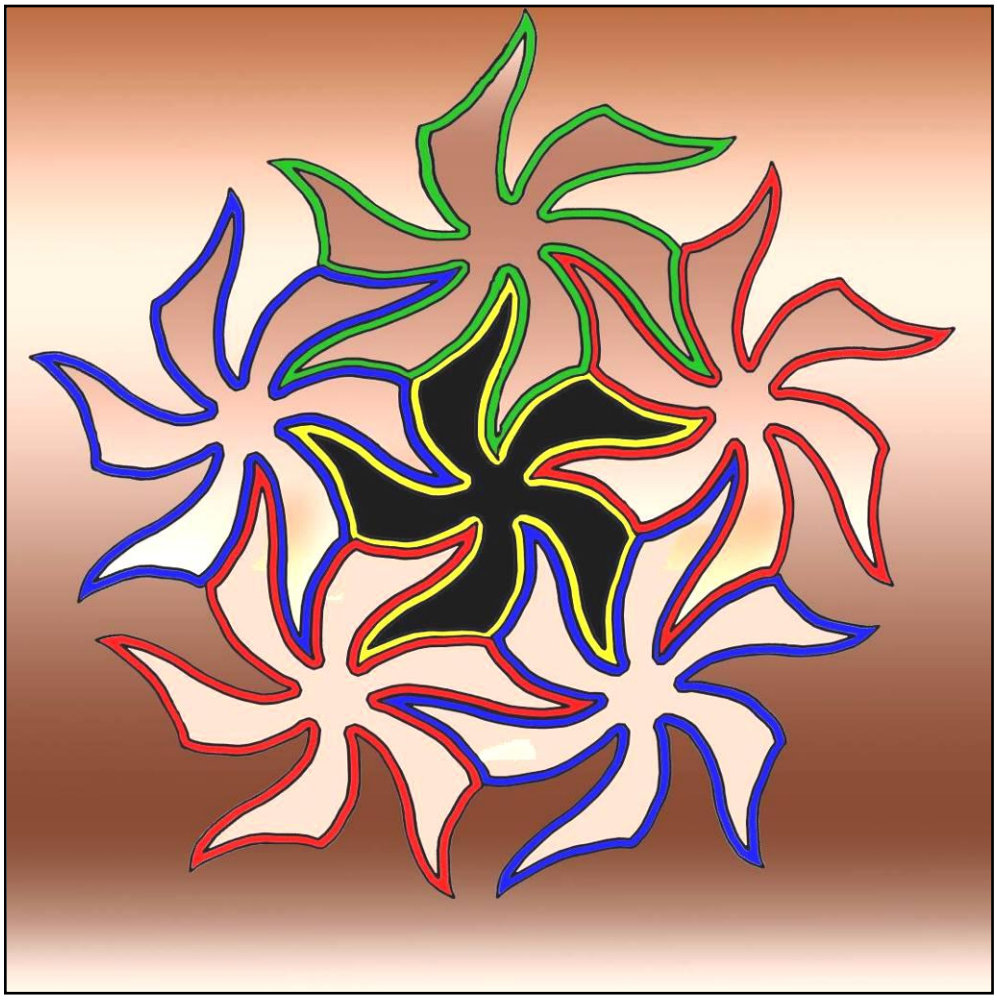


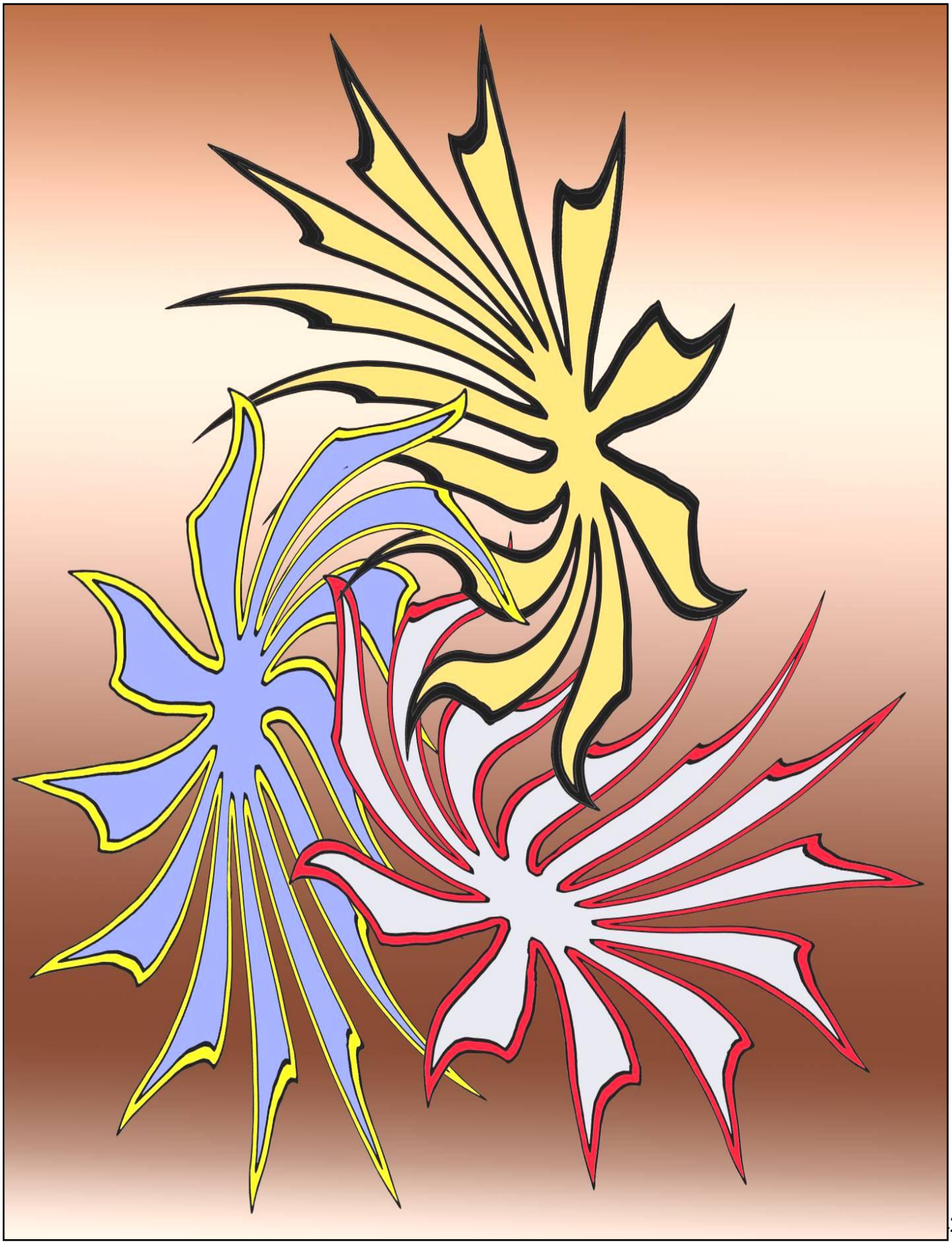


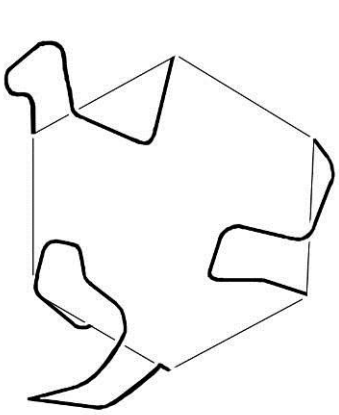
Hexagone régulier convexe : une symétrie centrale suivie de quatre rotations.

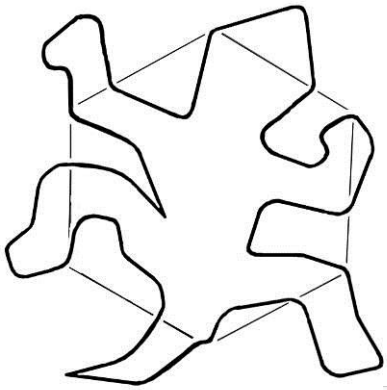




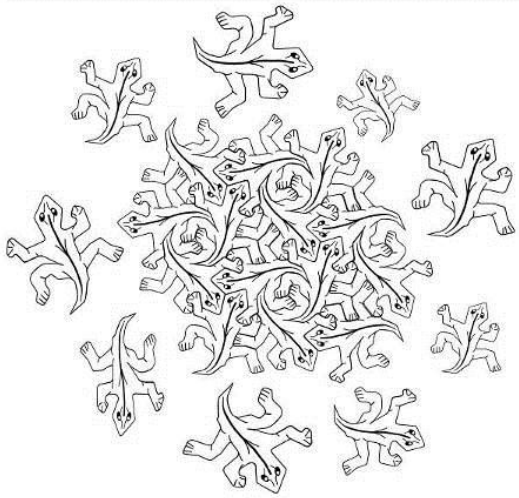




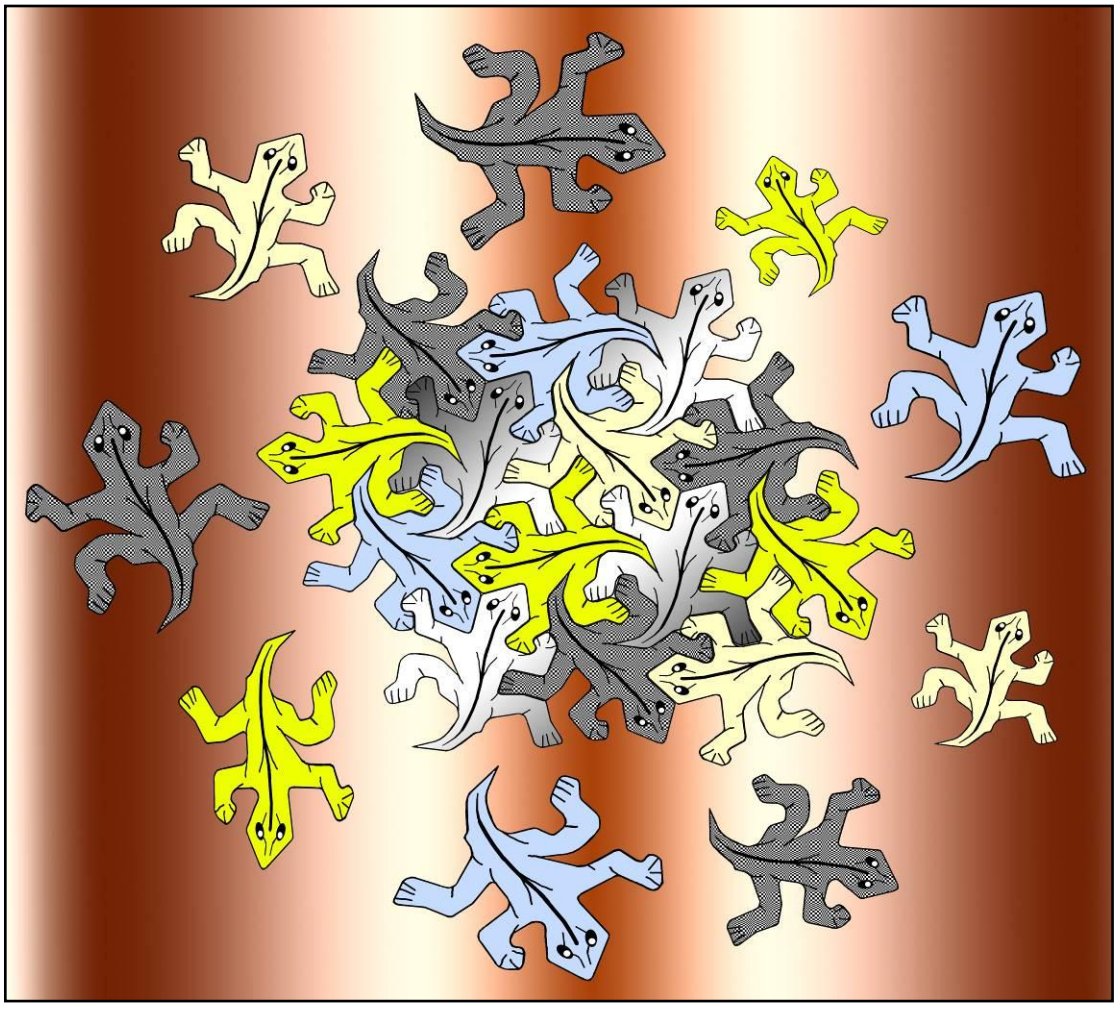


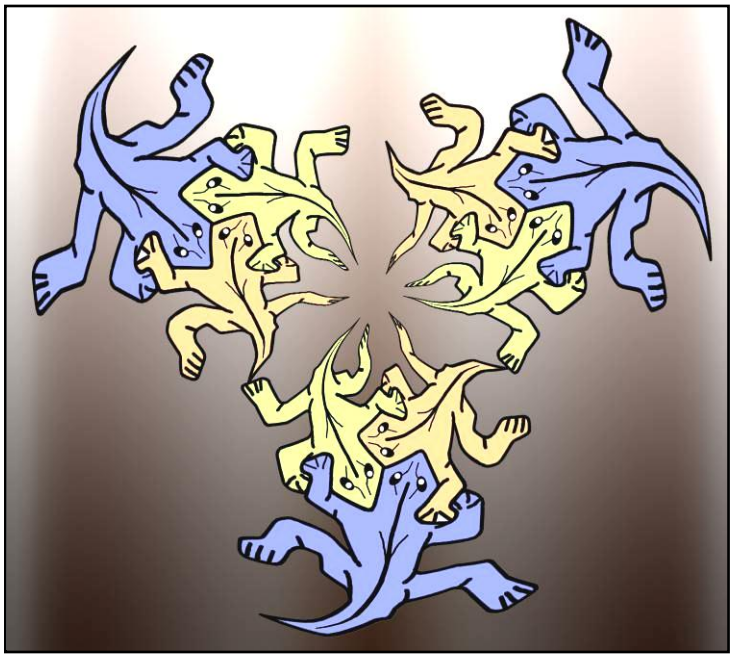


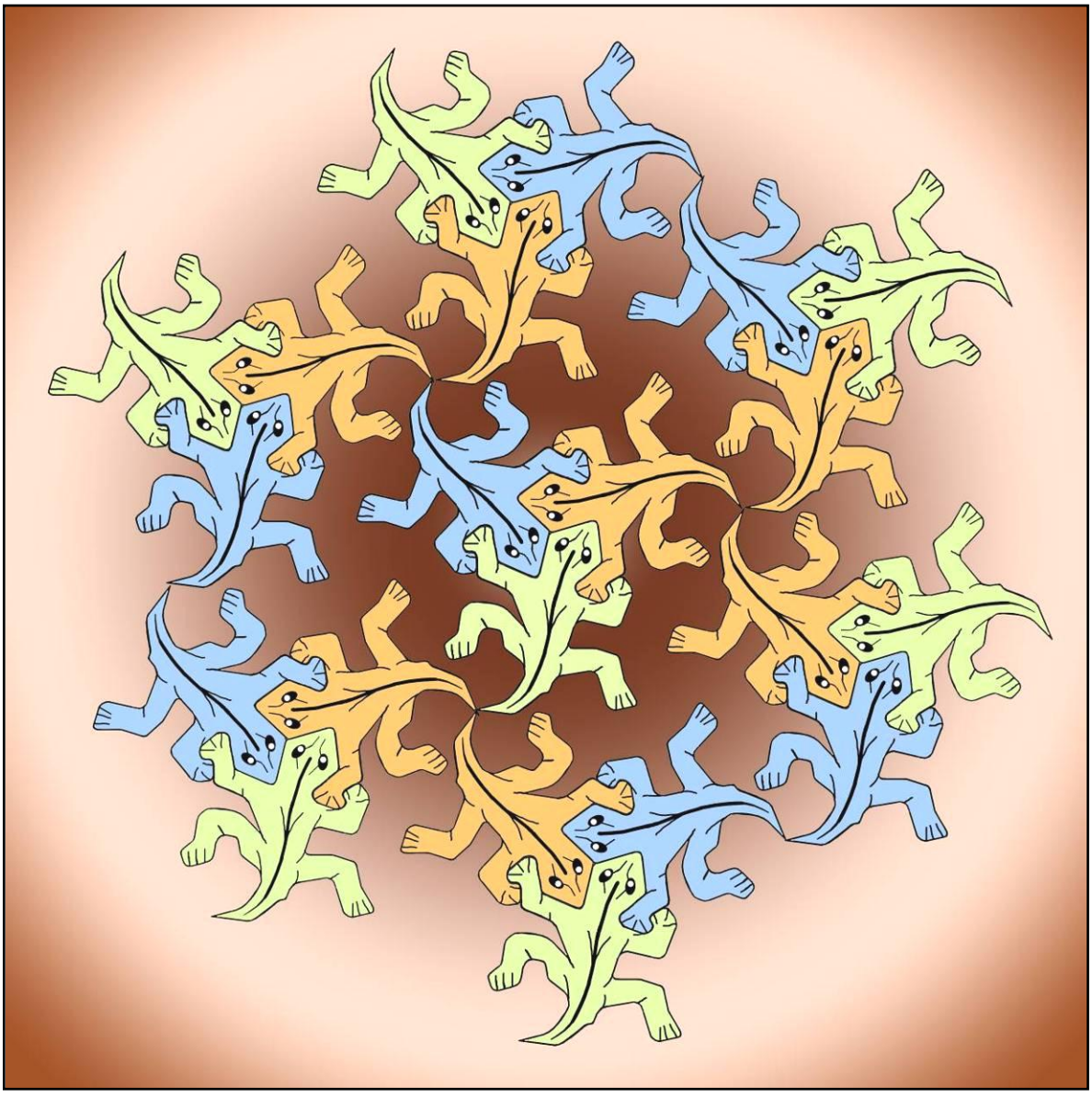
CONSTRUCTION

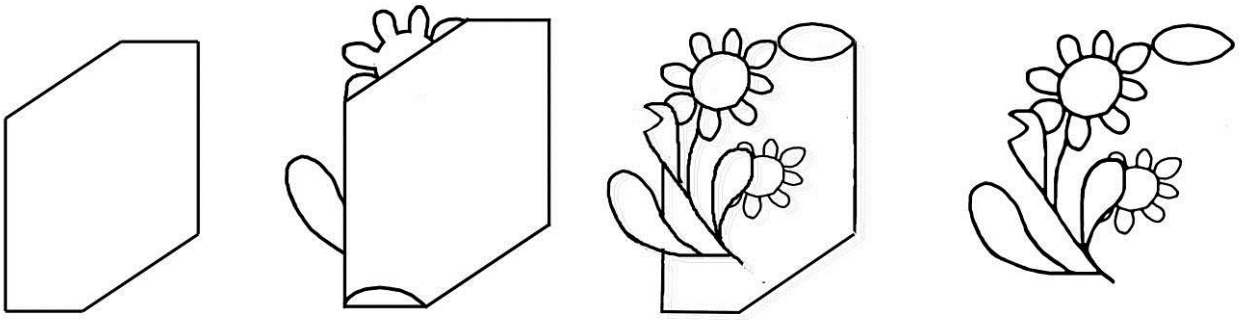


Hexagone régulier convexe : quatre rotations successives.

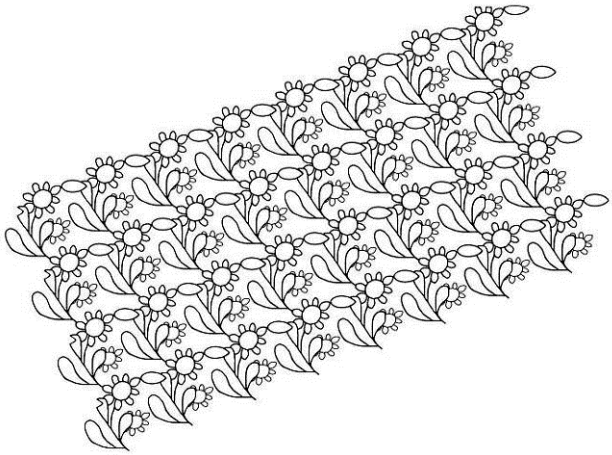


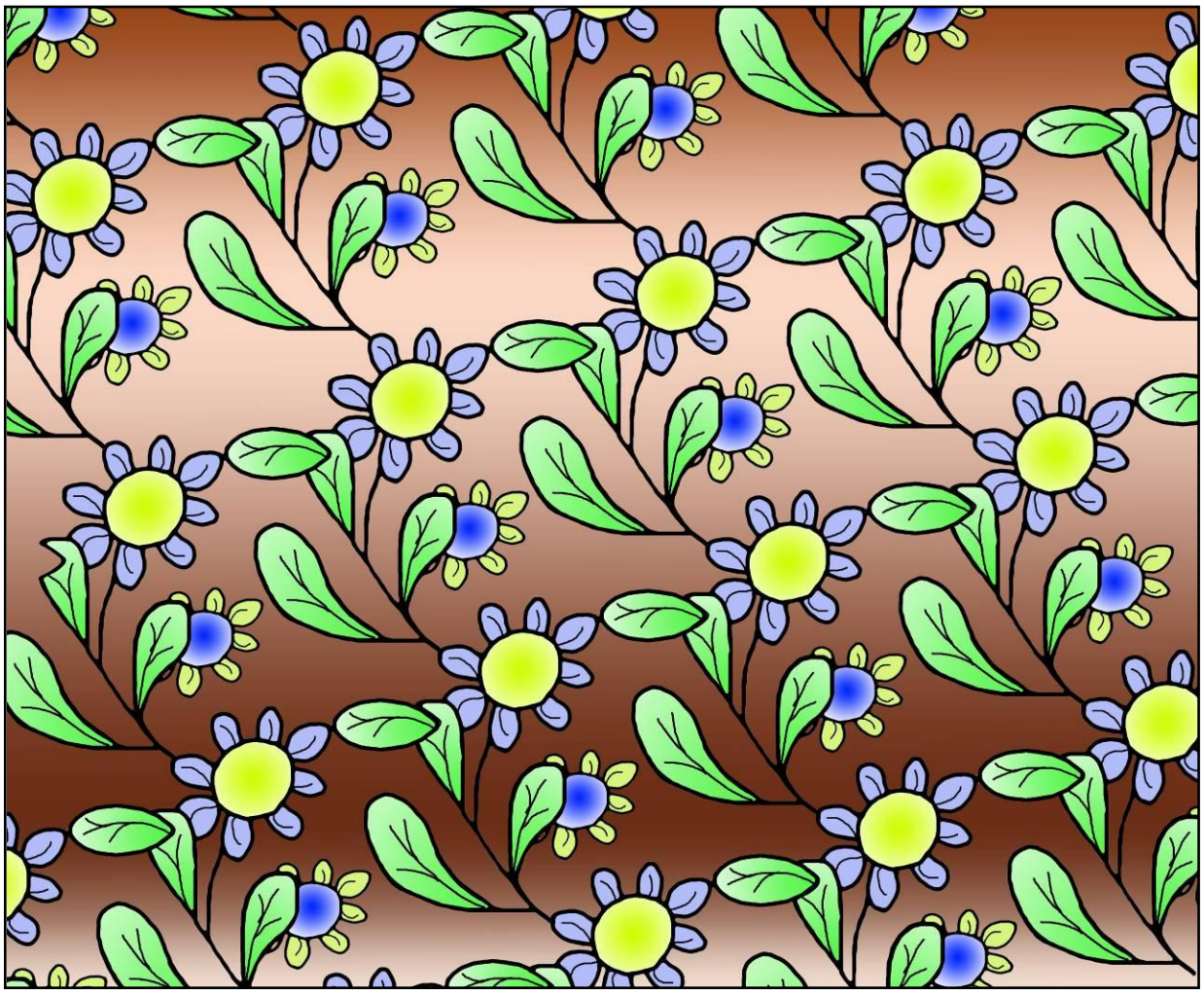


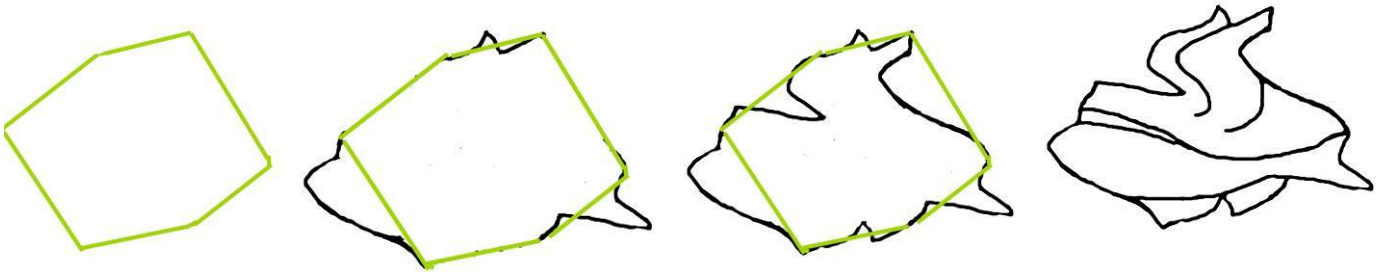




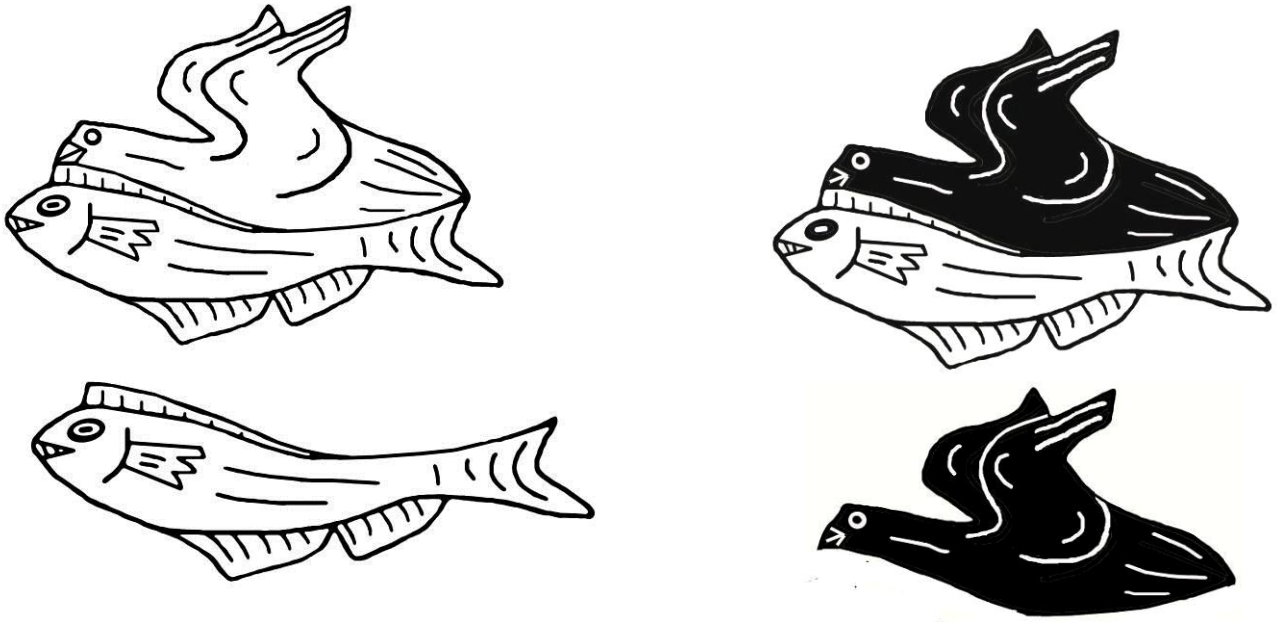
Hexagone aux côtés parallèles et isométriques.

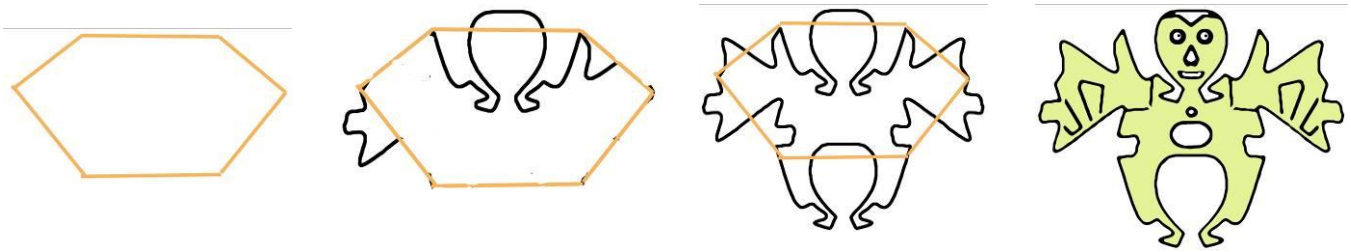




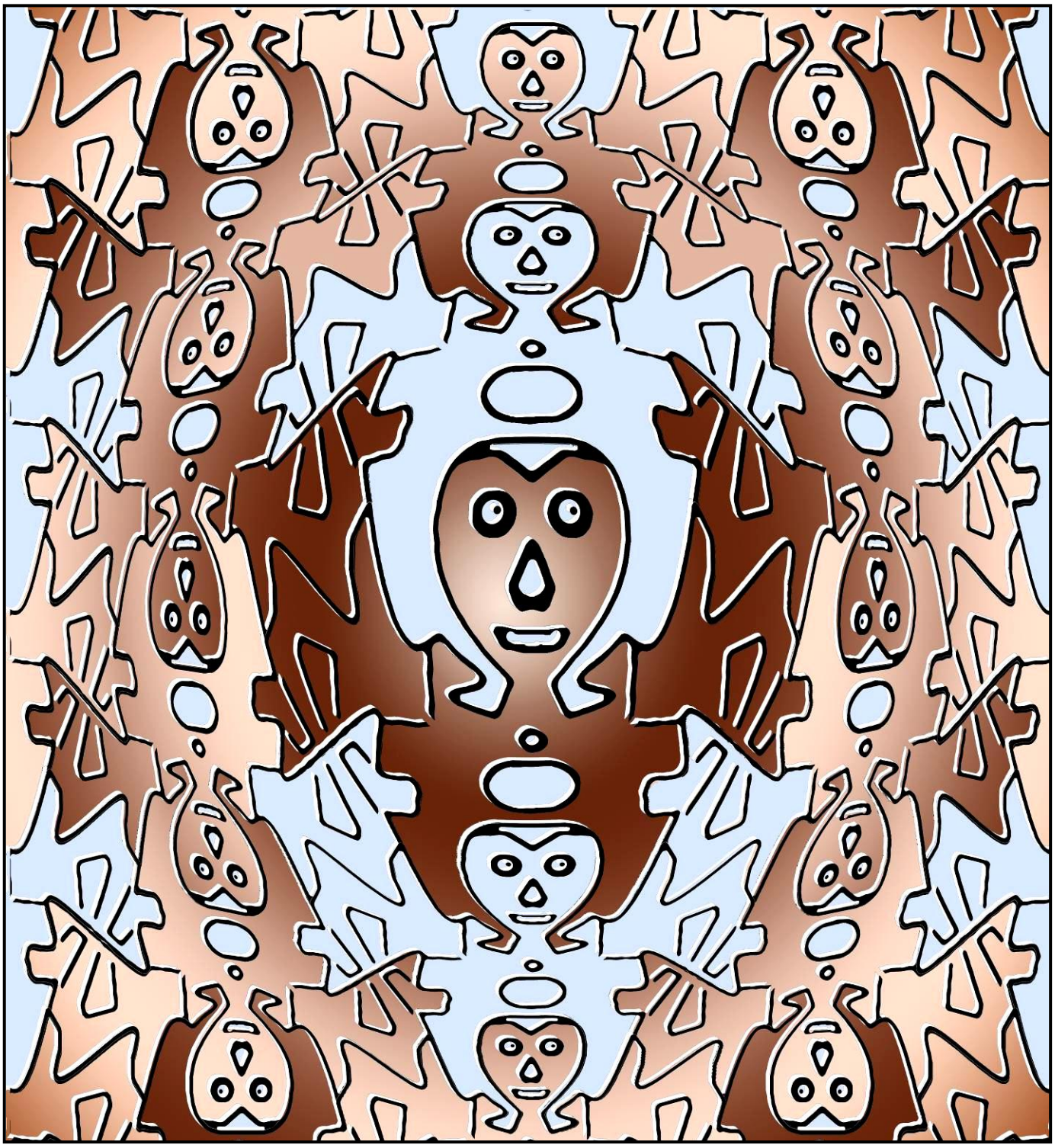


Hexagone : trois translations.

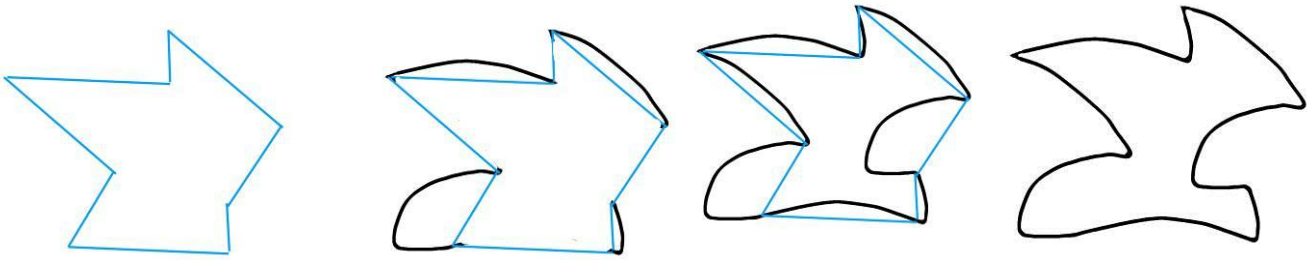




Hexagone : deux symétries centrales, une translation et deux réflexions glissées.

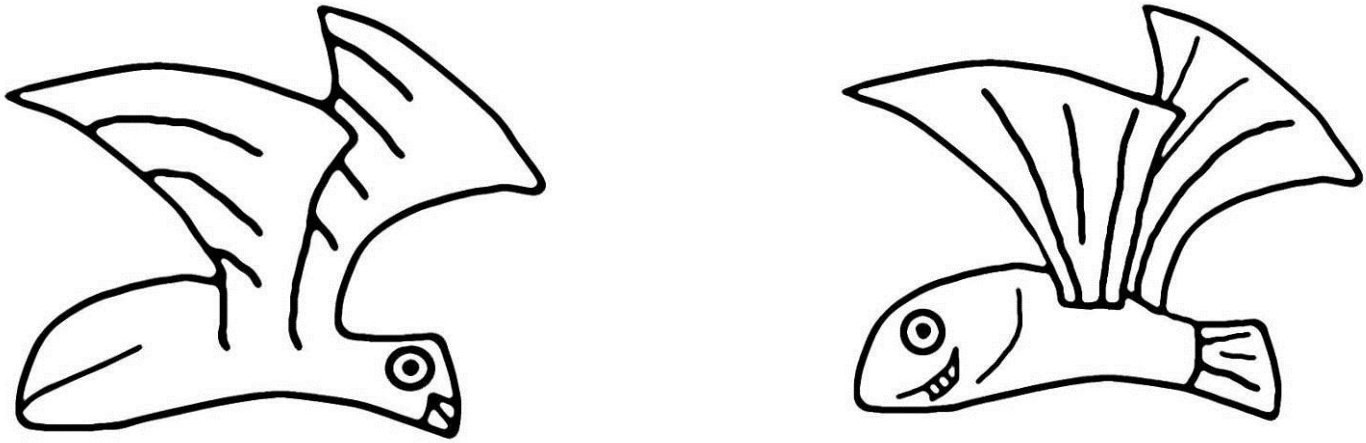


d) polygones quelconques :

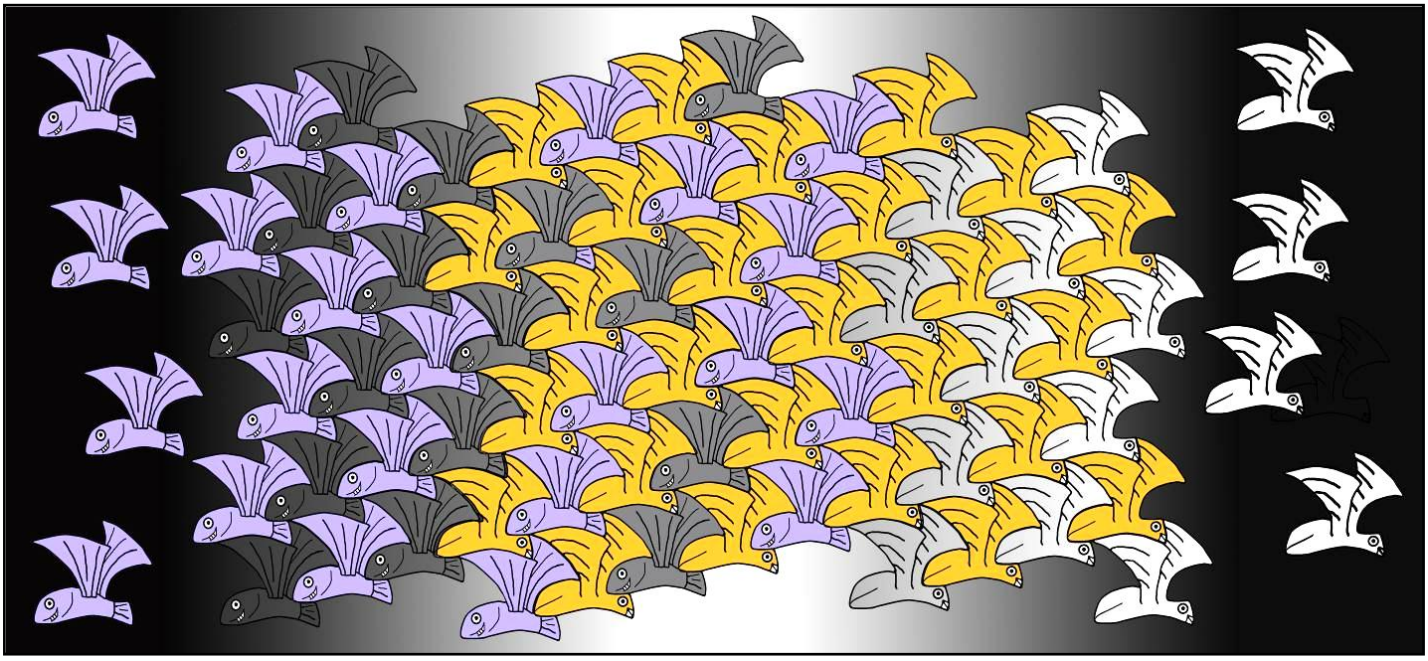


Octogone irrégulier : quatre translations.

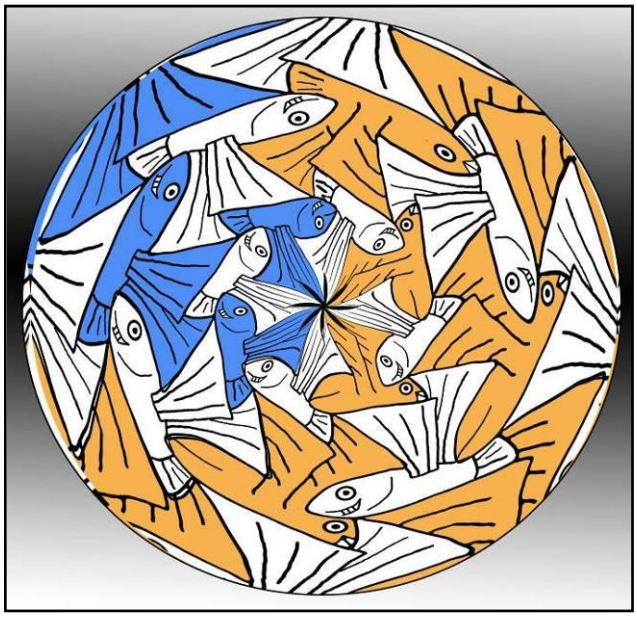
CONSTRUCTION

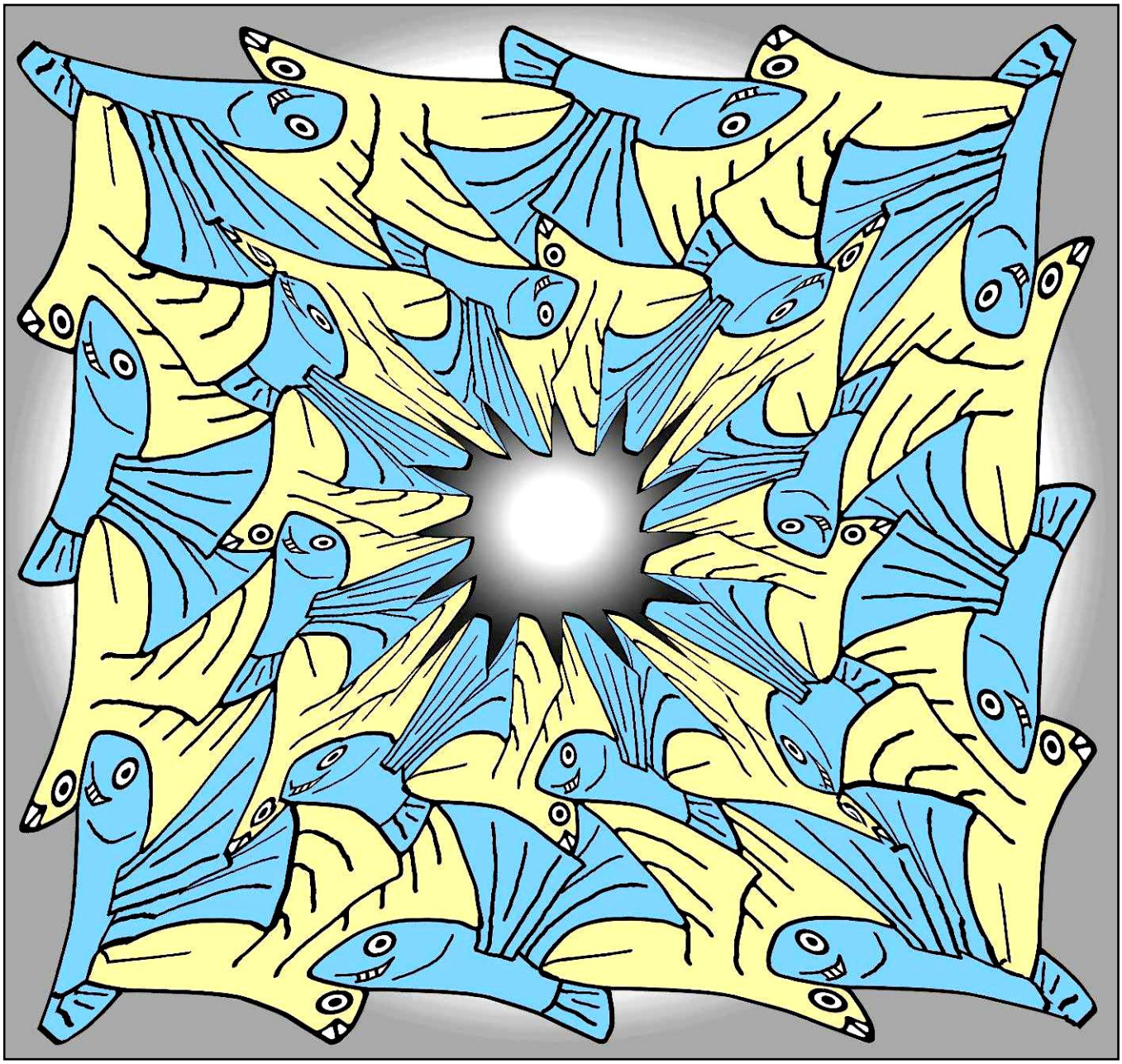


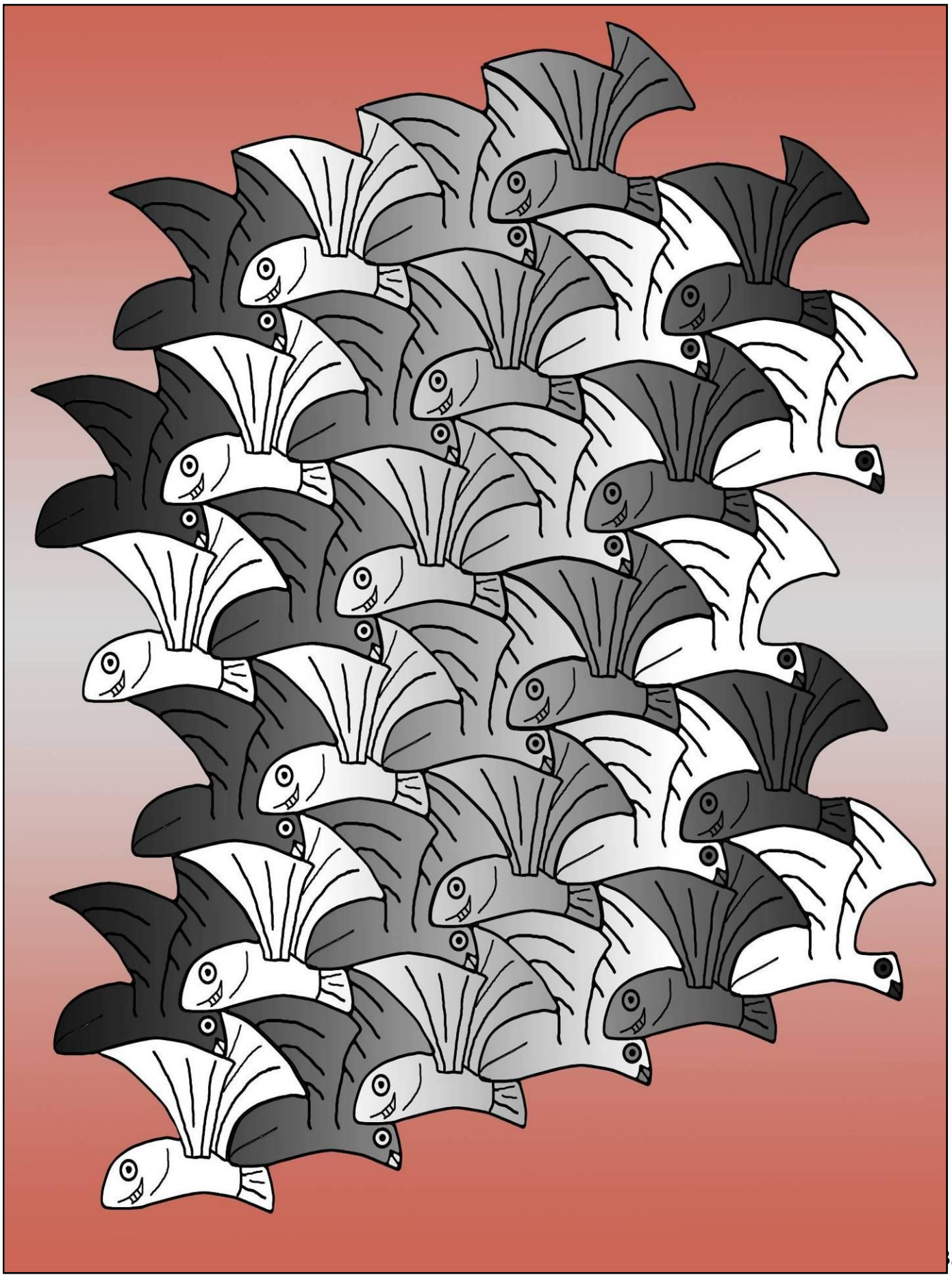
Le même pavé sert pour l'oiseau et le poisson volant.

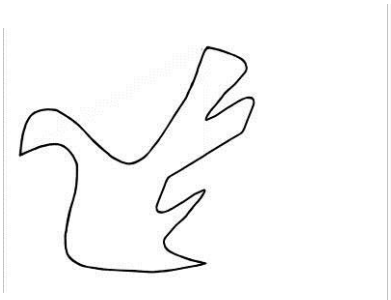
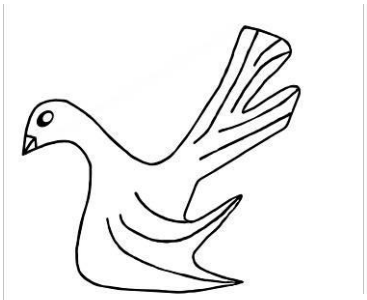


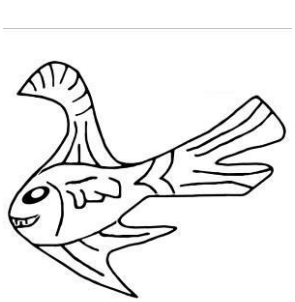
CONSTRUCTION

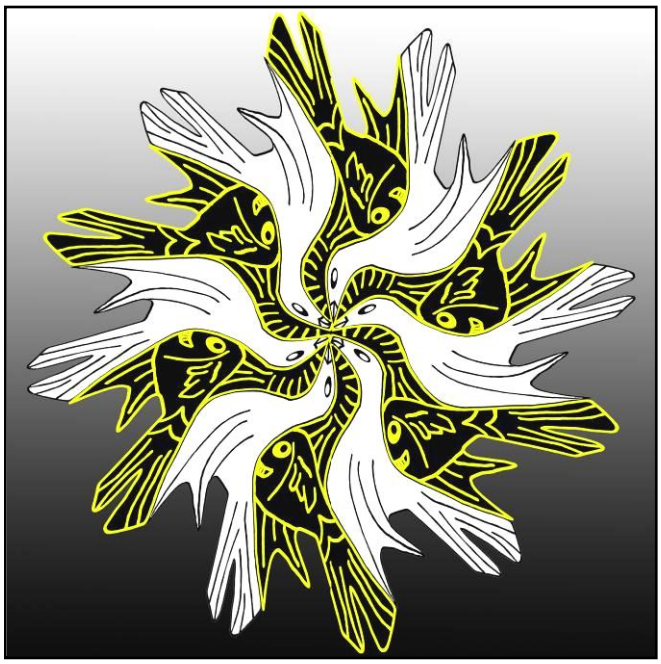
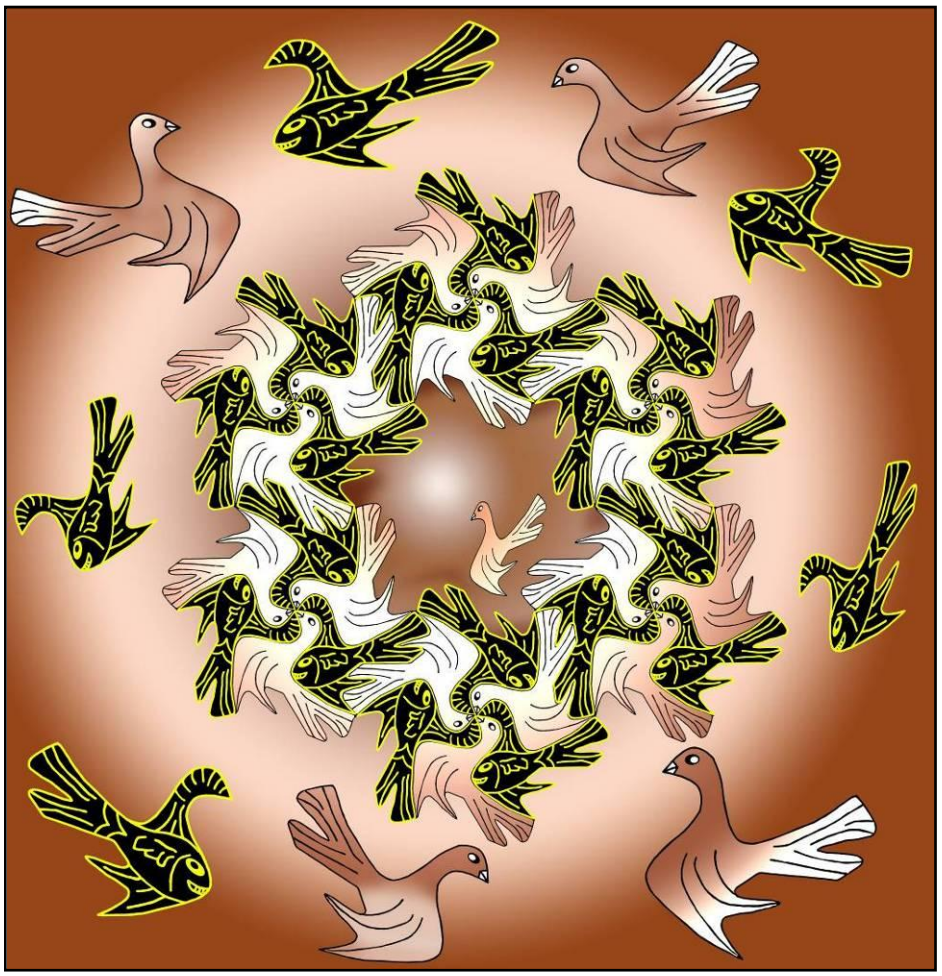




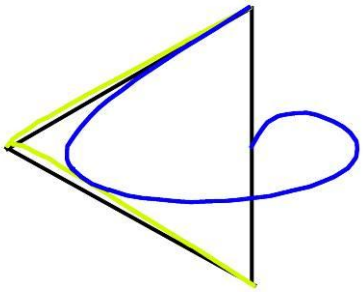


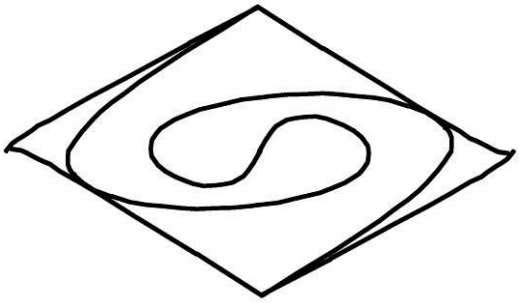



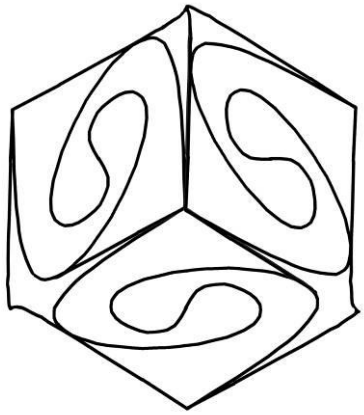


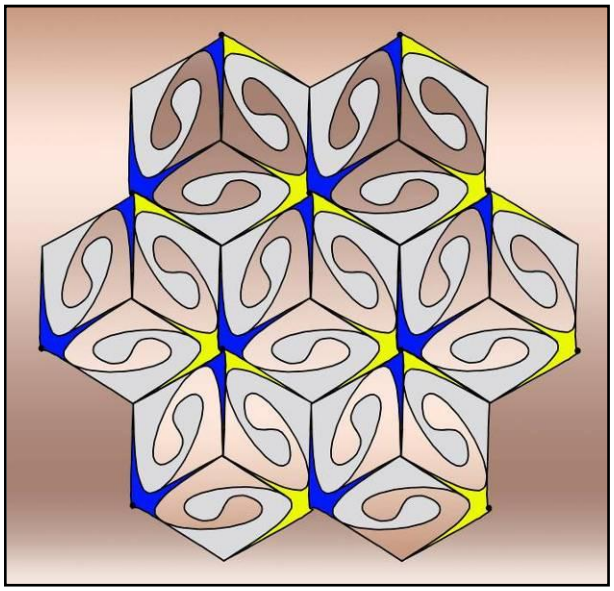



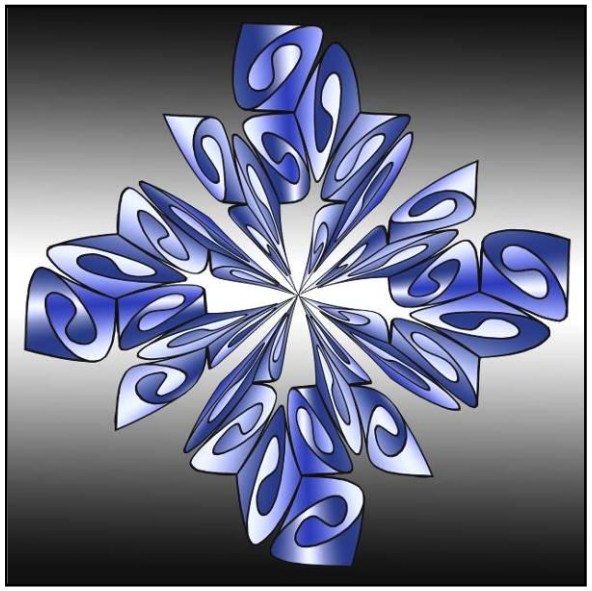
CONSTRUCTION

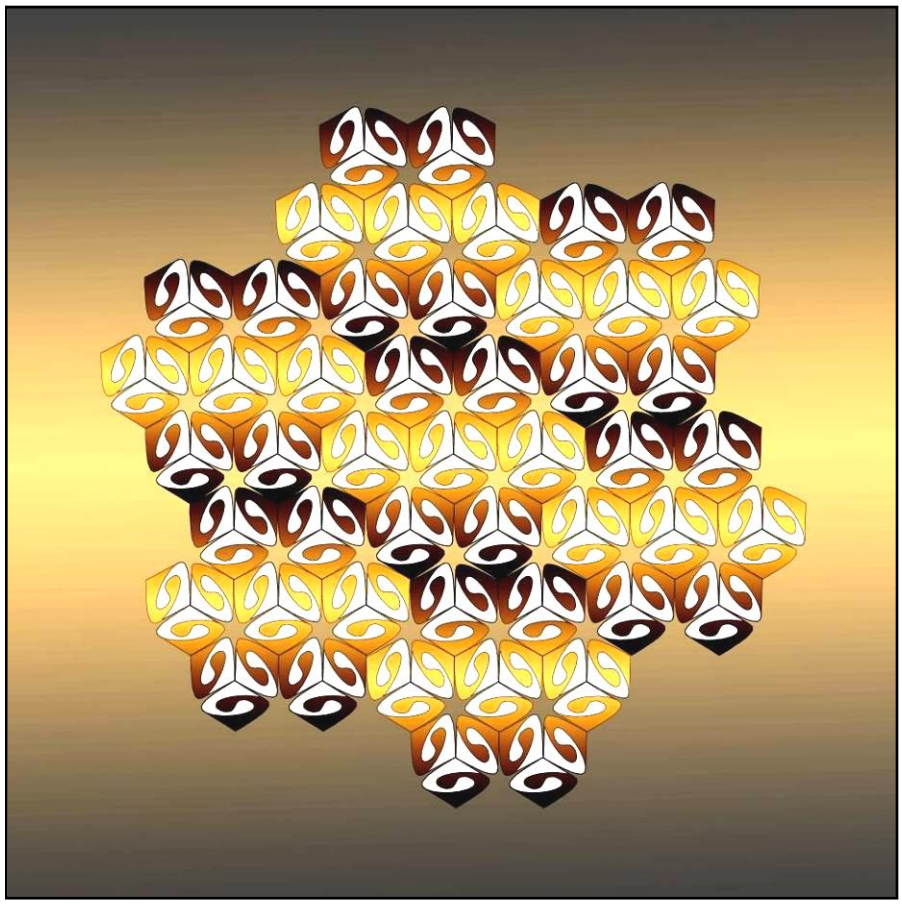




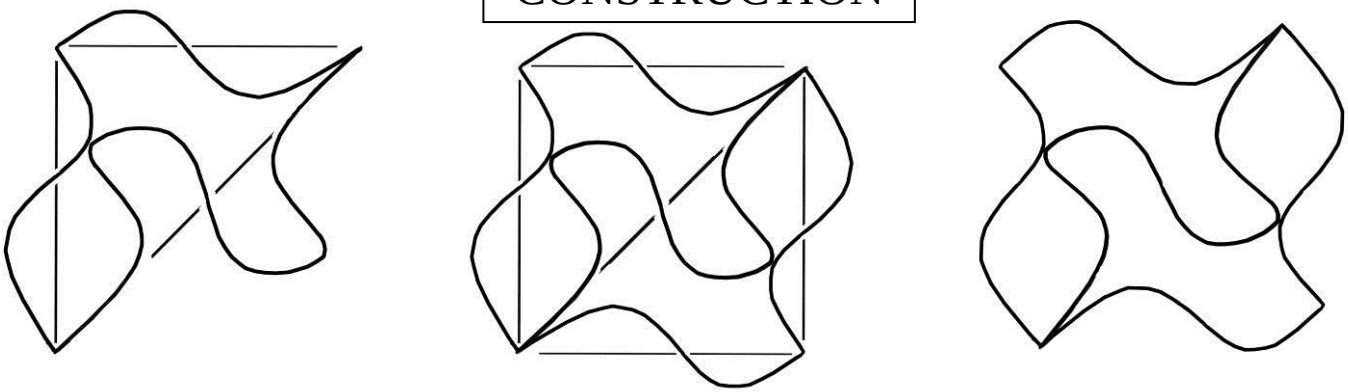


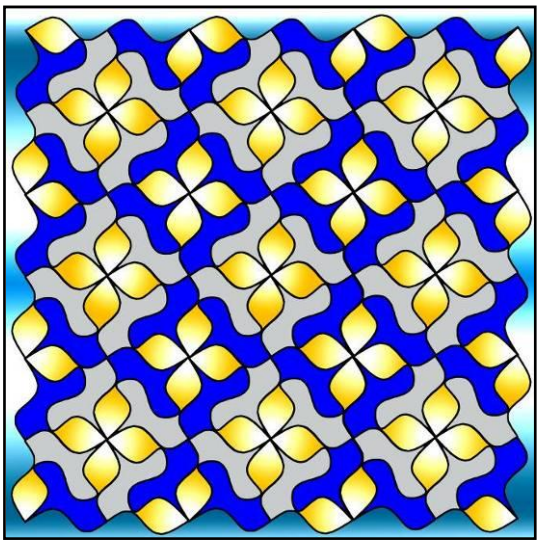


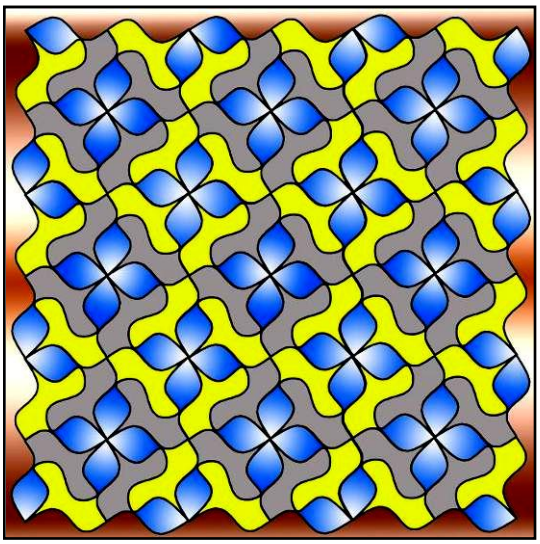


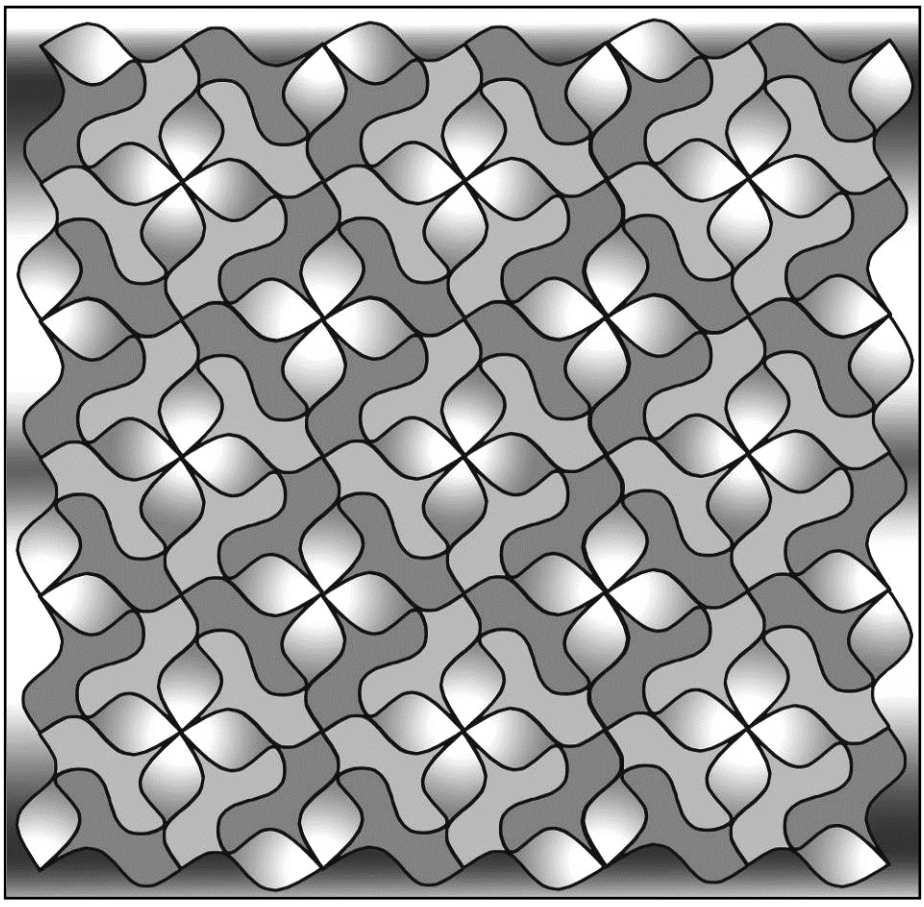


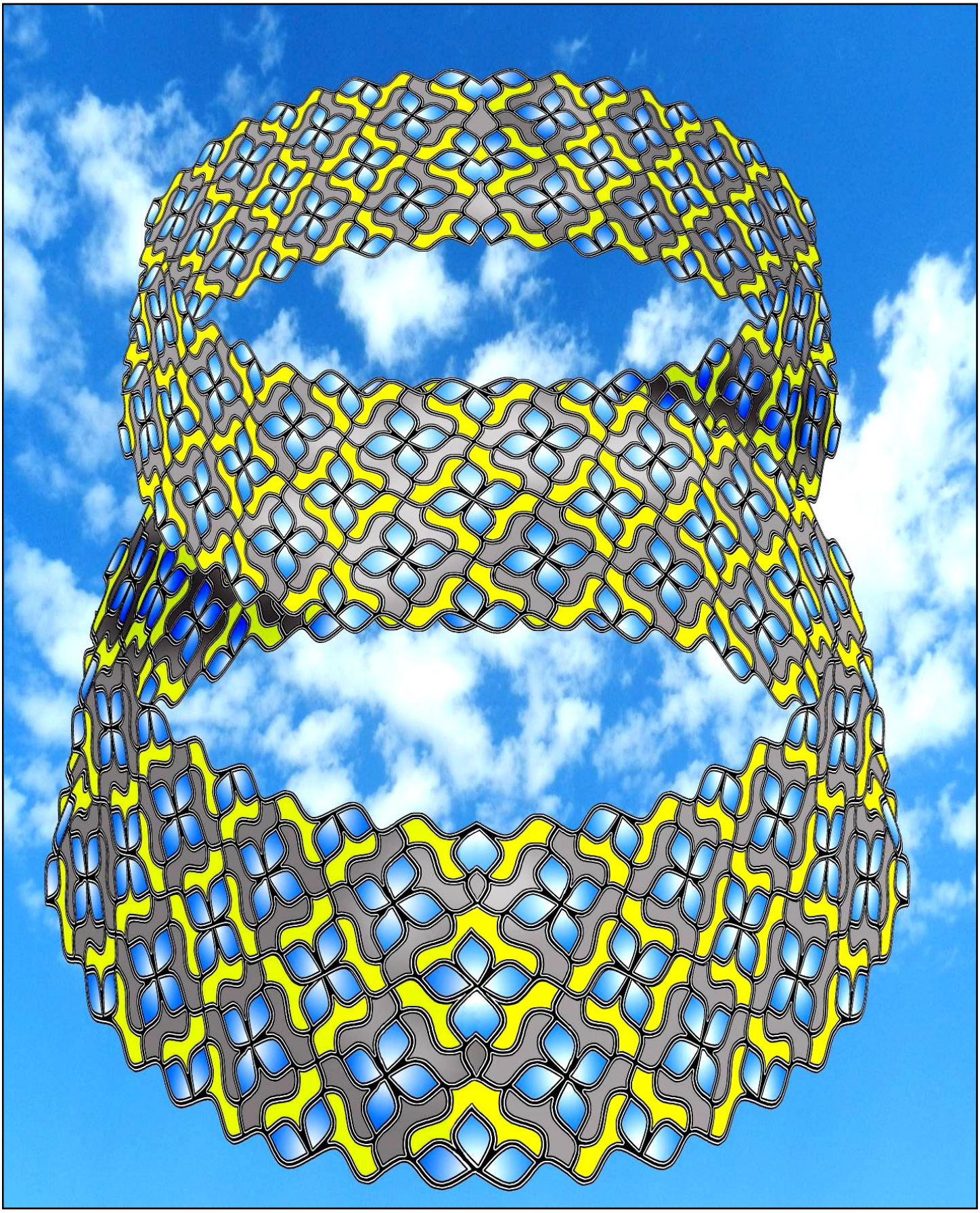
CONSTRUCTION



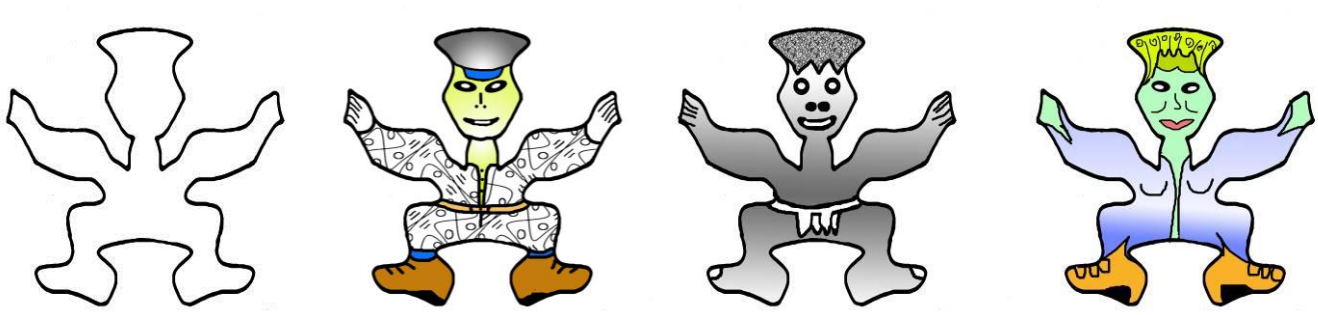


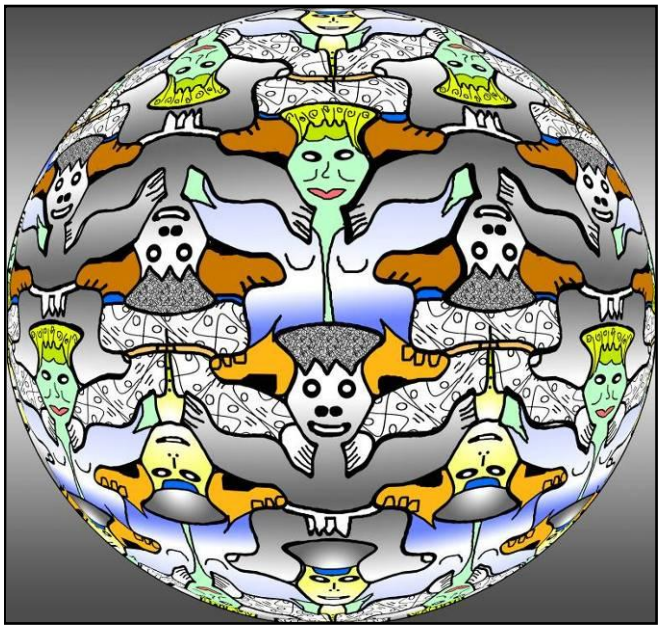


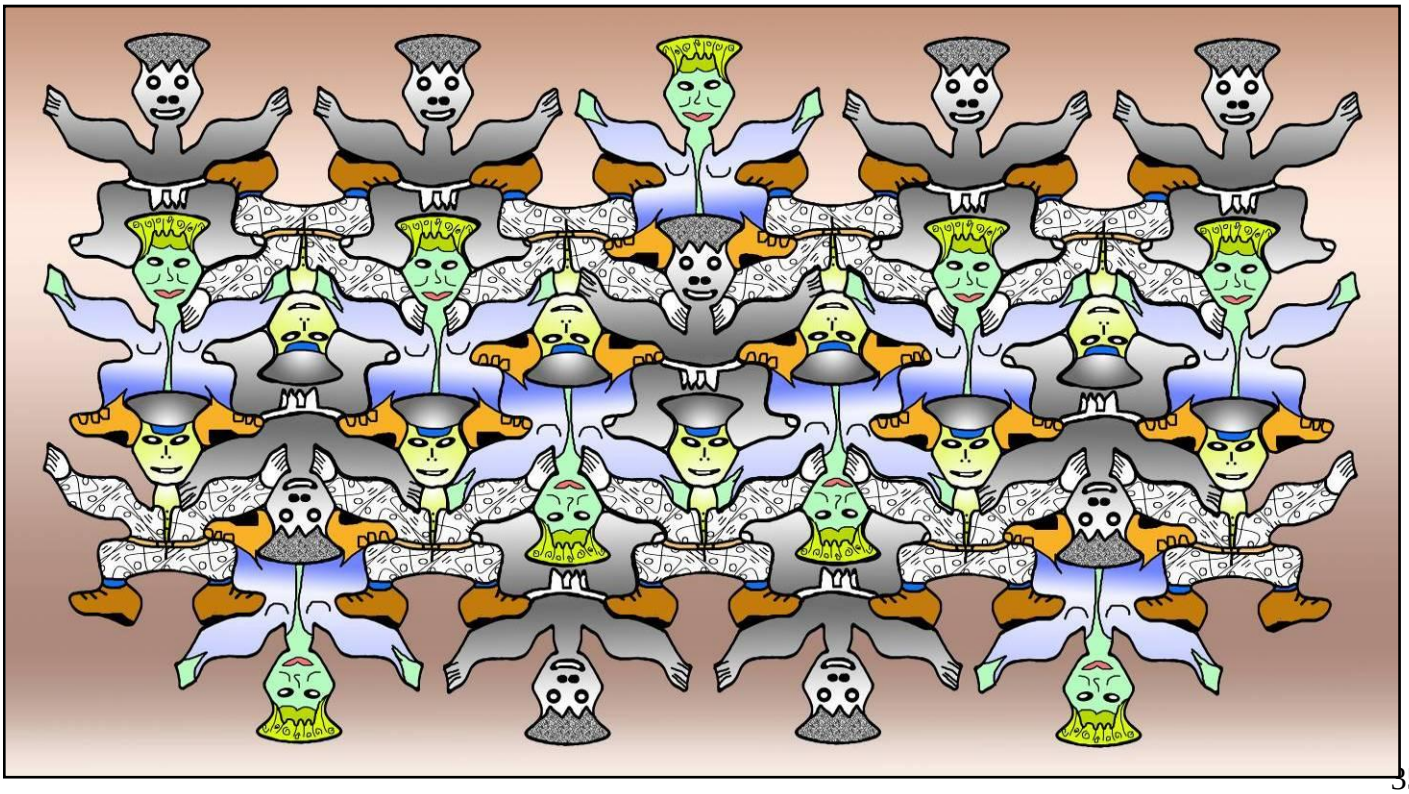




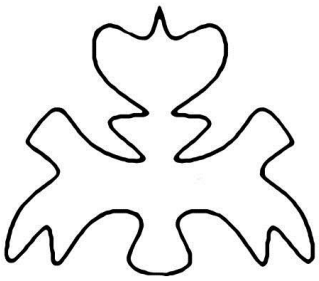
e) Plusieurs motifs pour un même pavé :

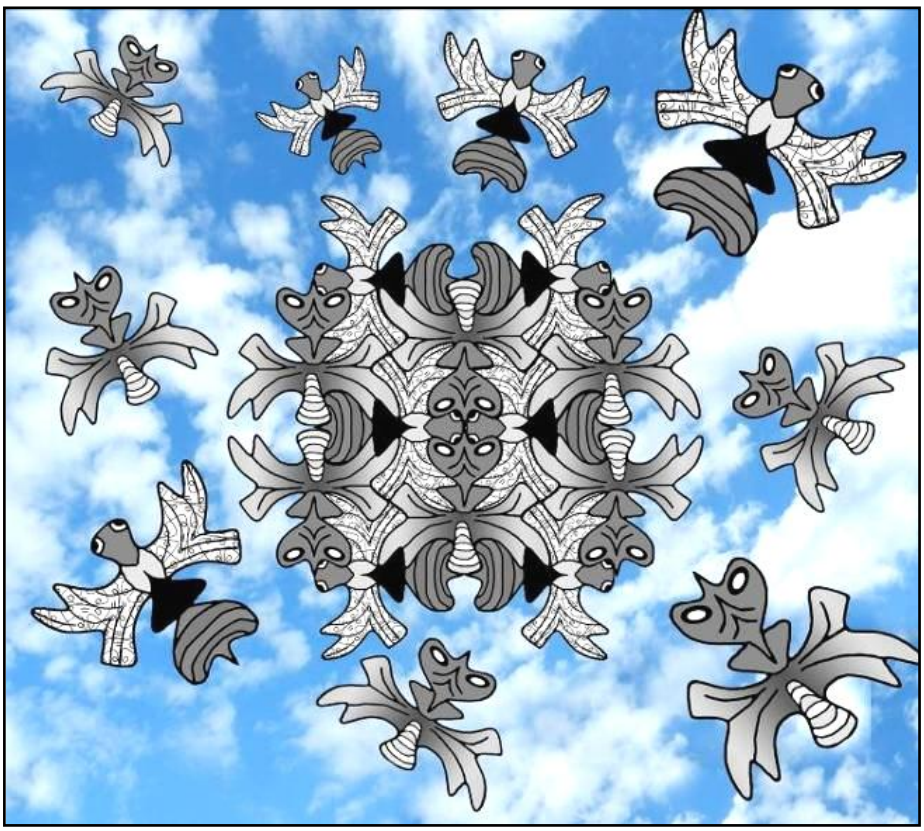


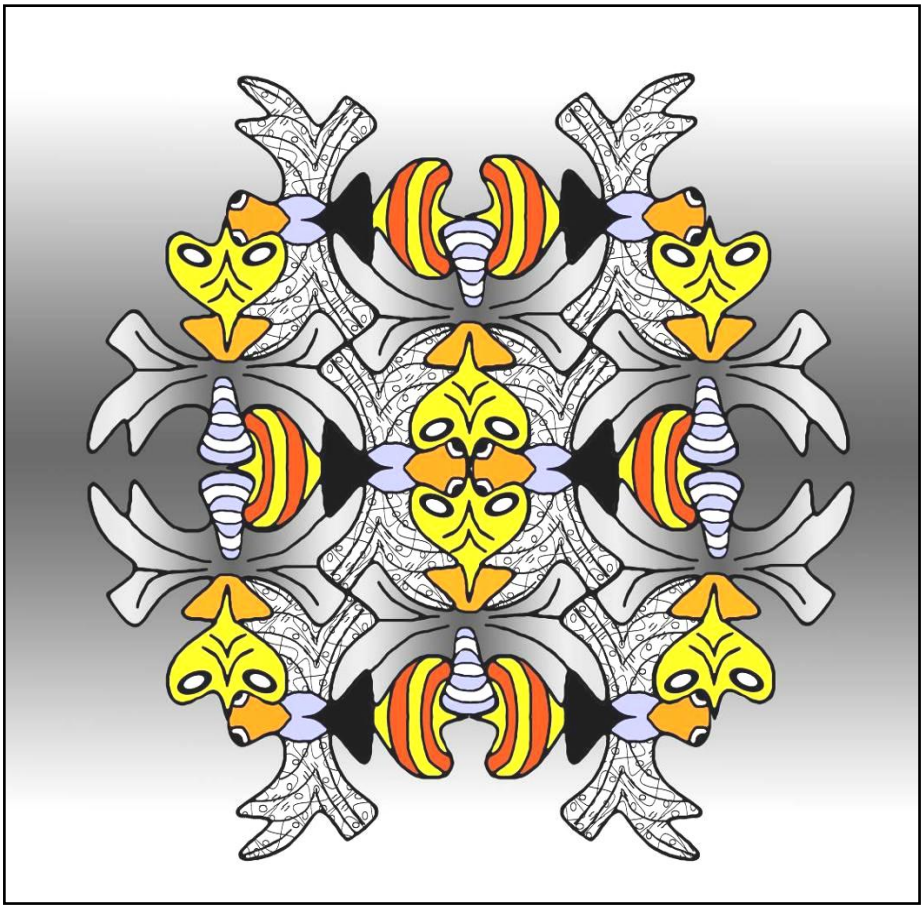




CONSTRUCTION







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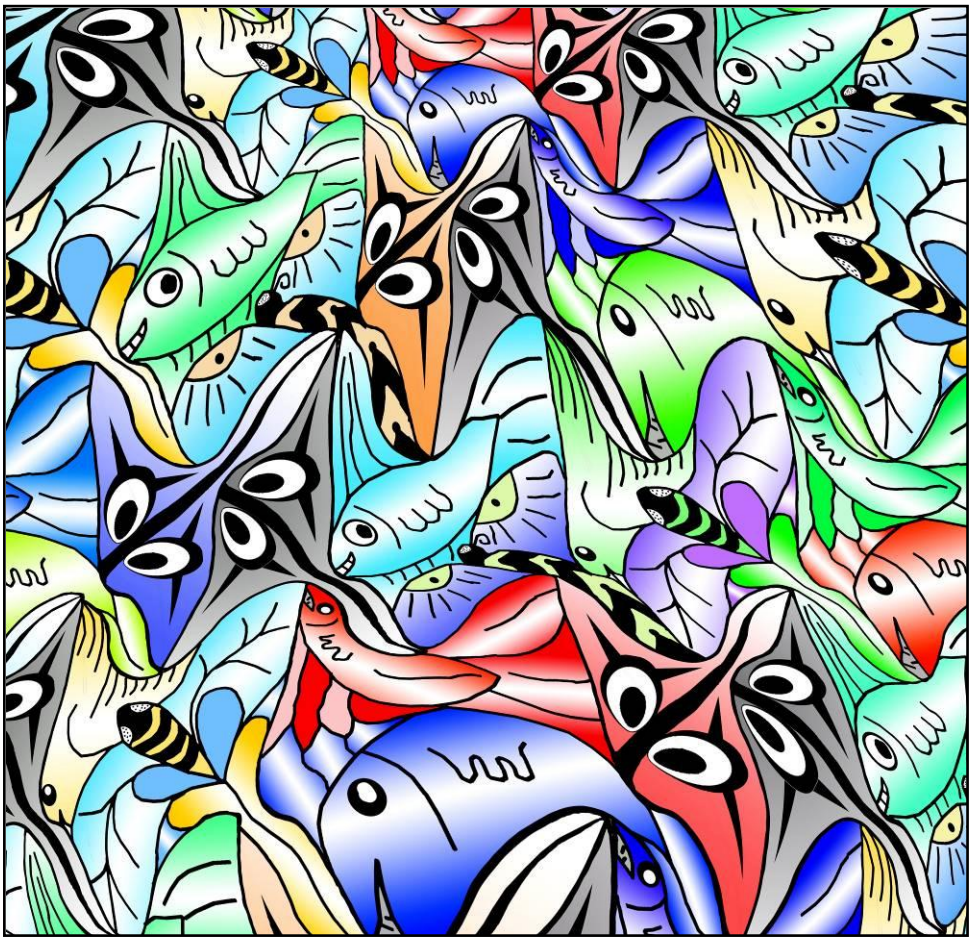

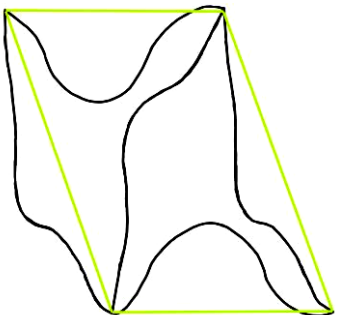

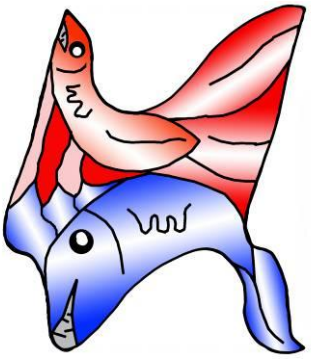

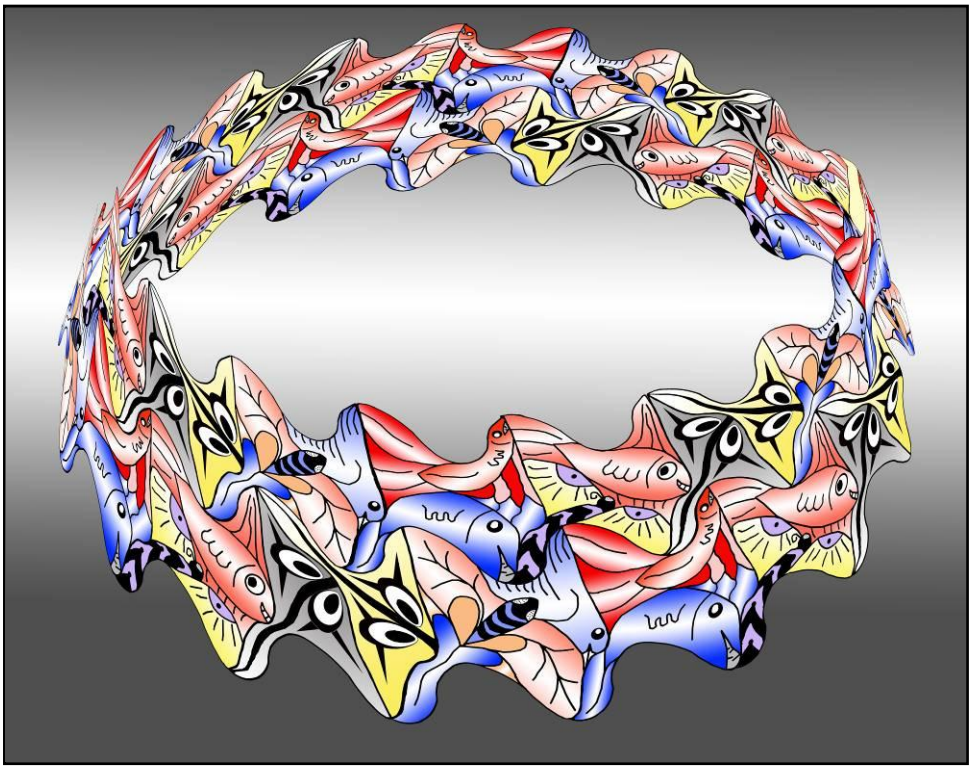

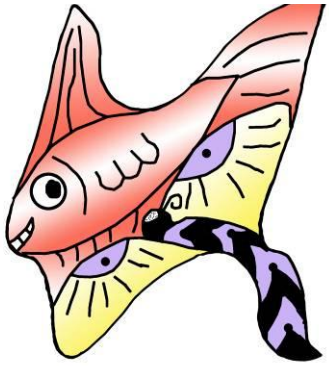

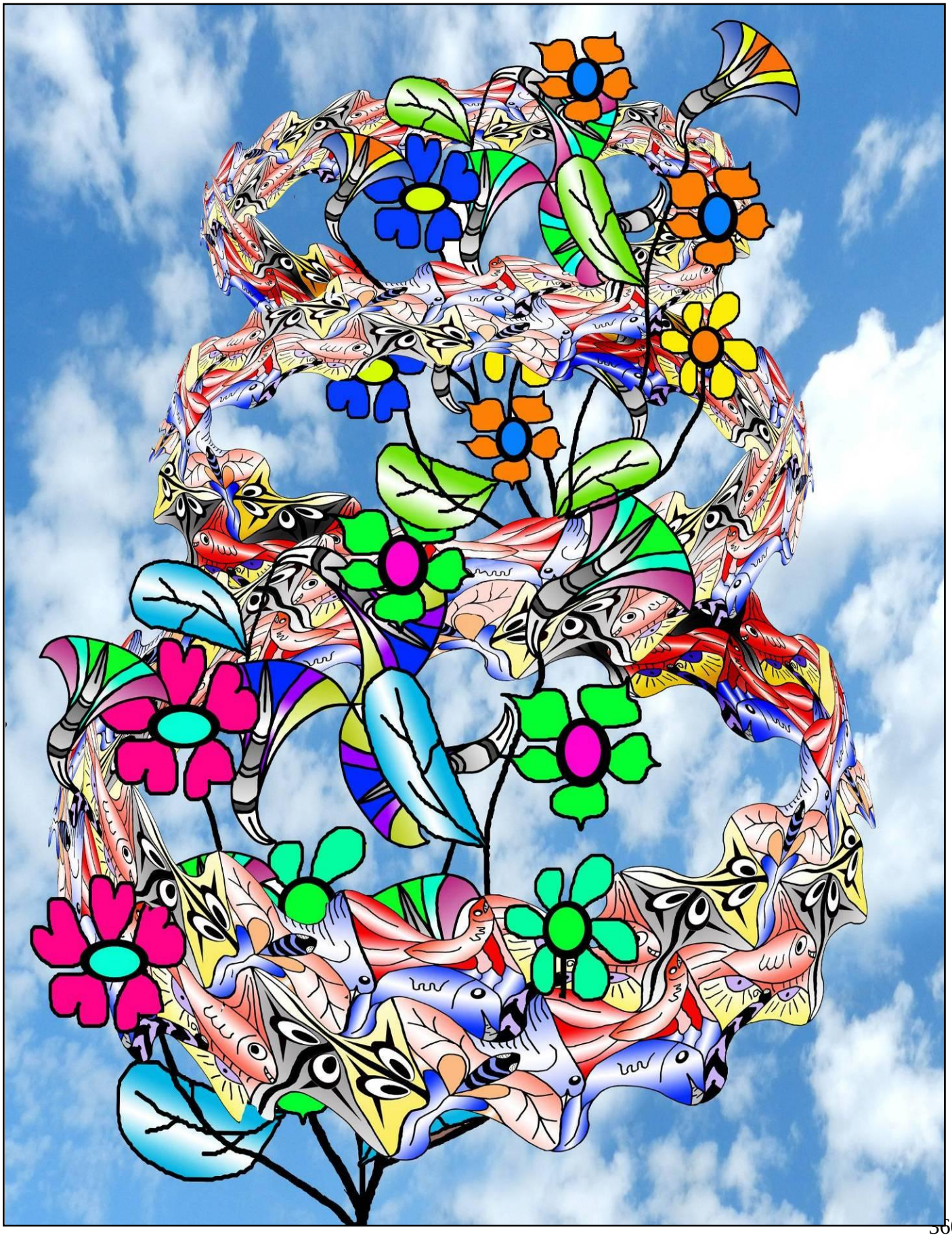

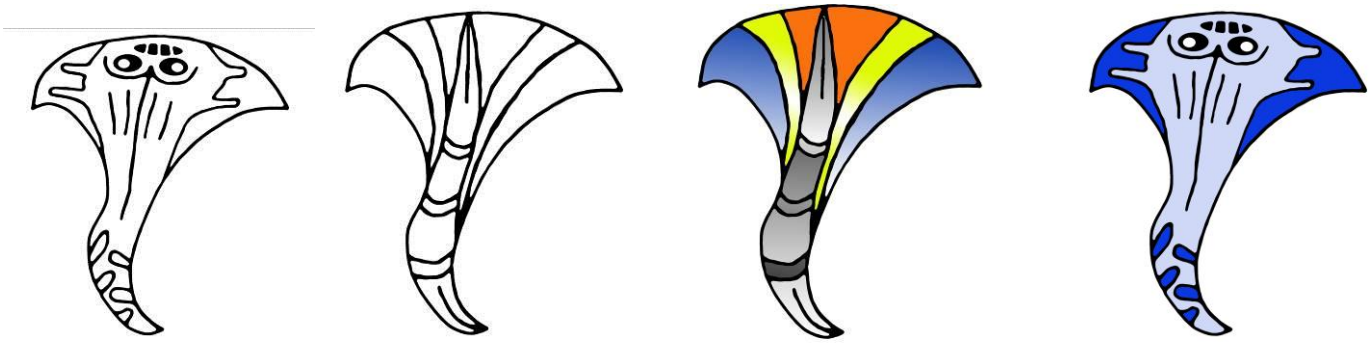

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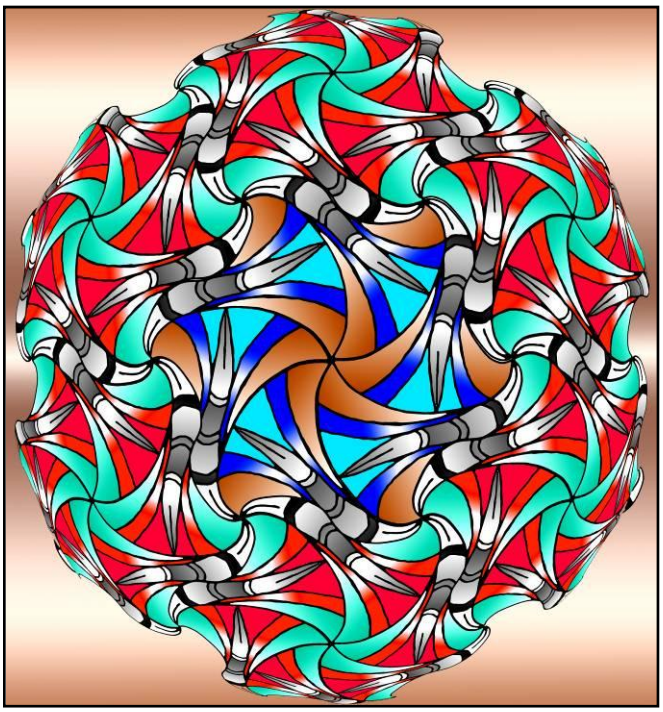
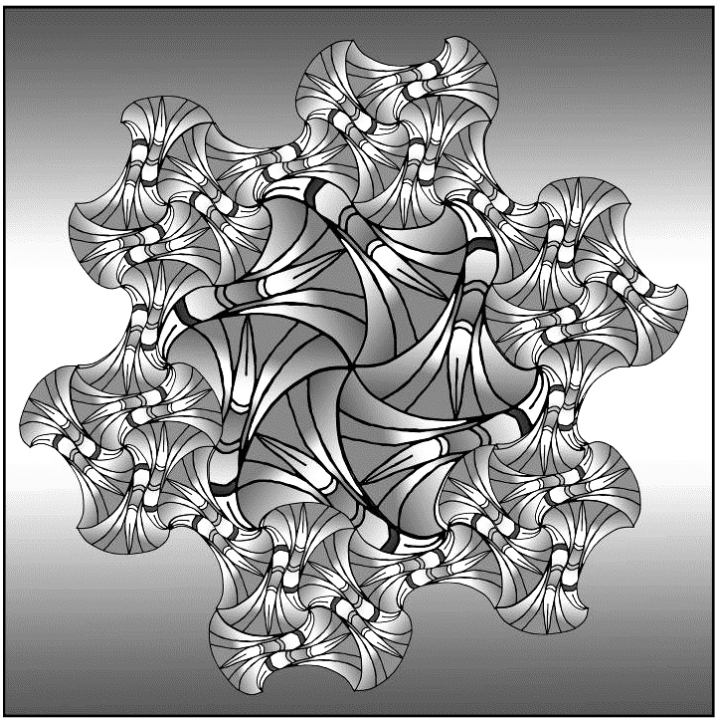
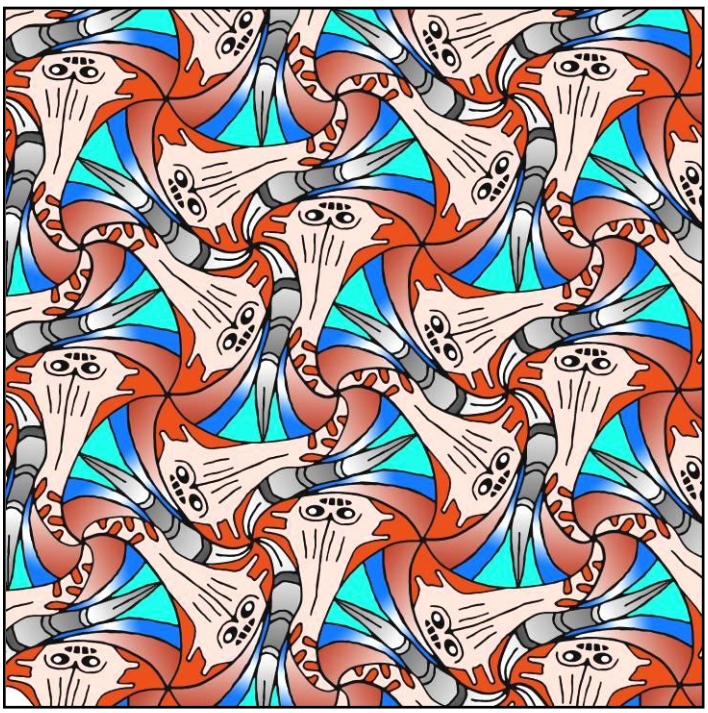
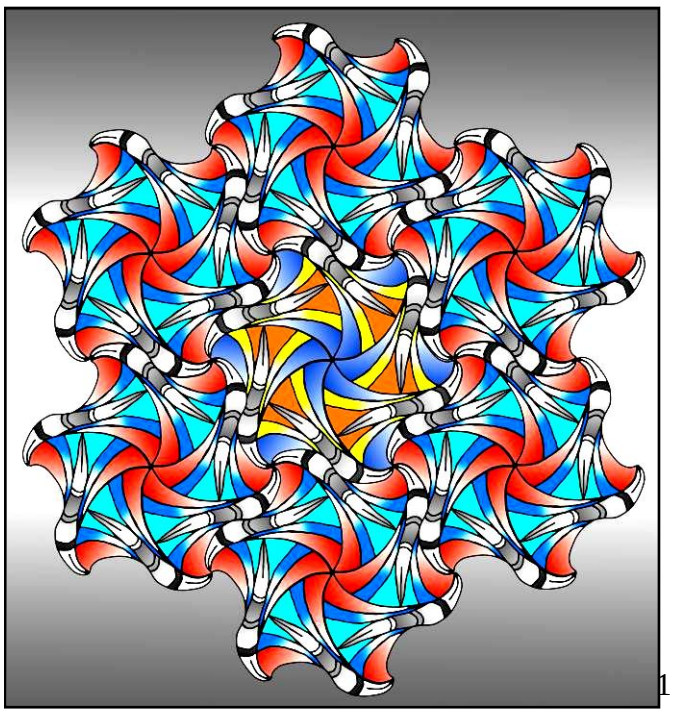
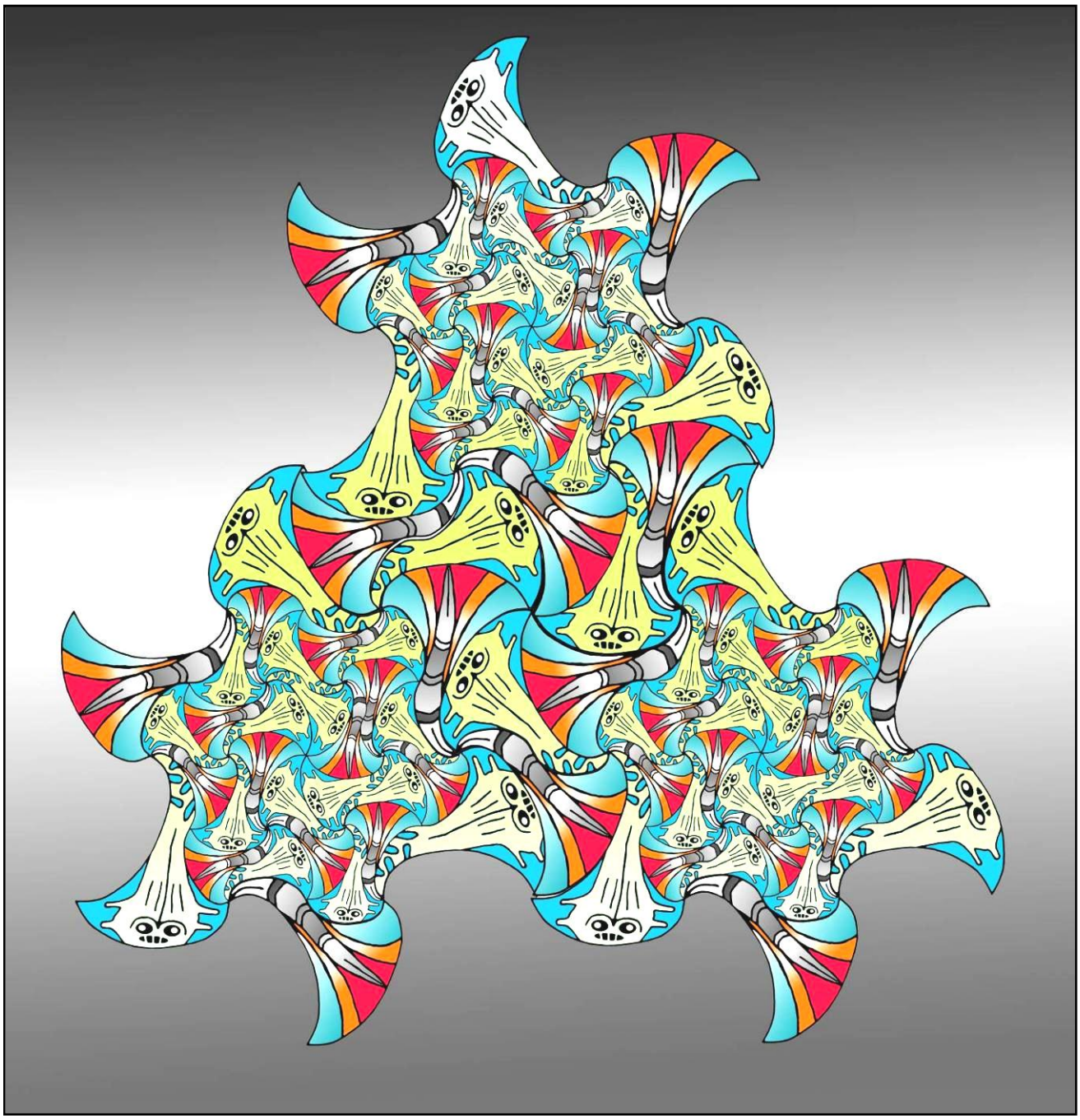
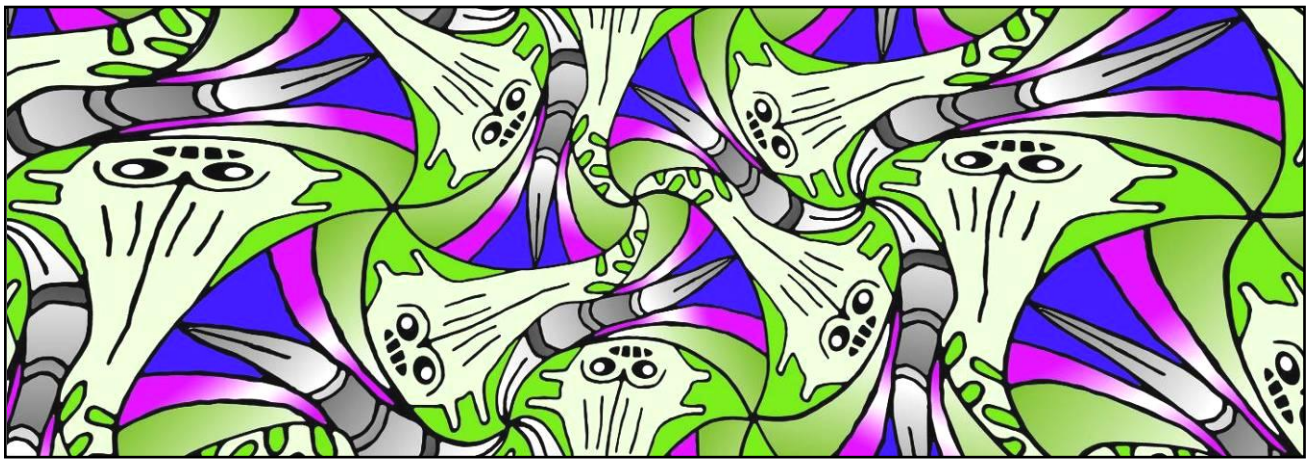


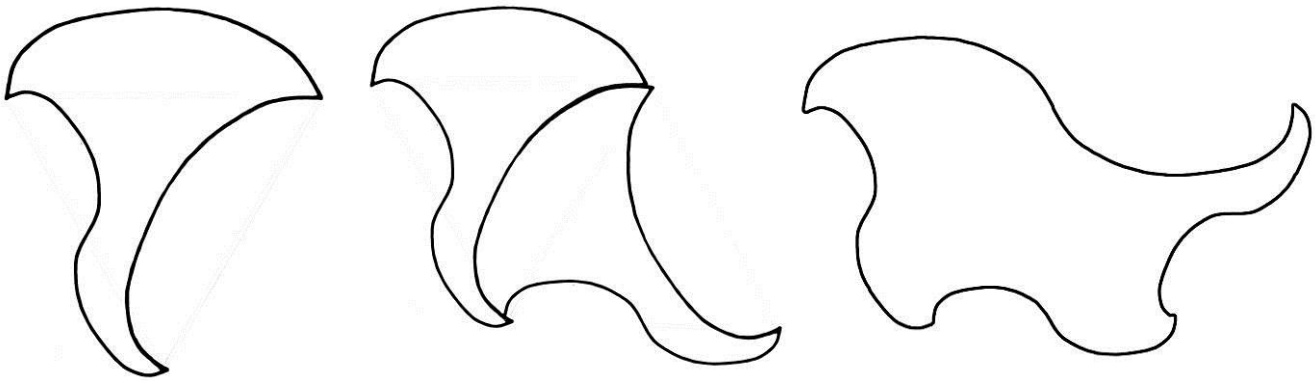


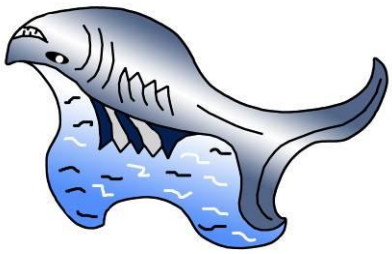


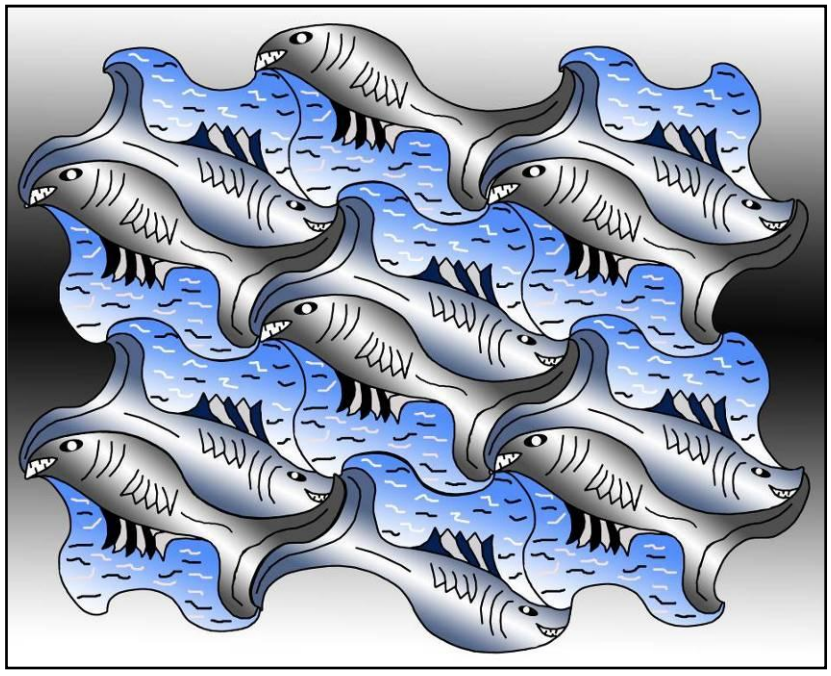


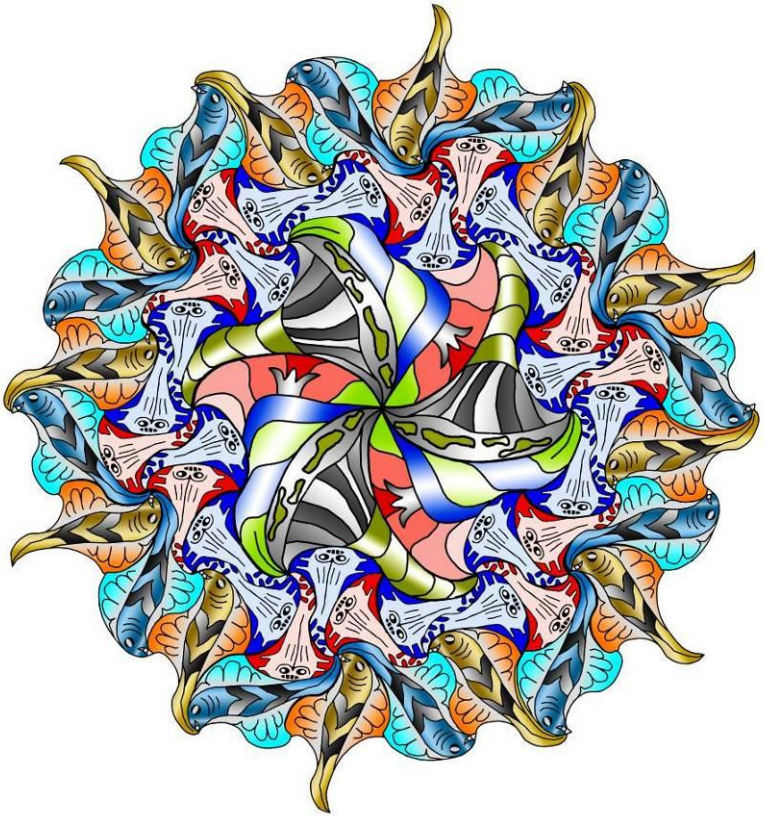


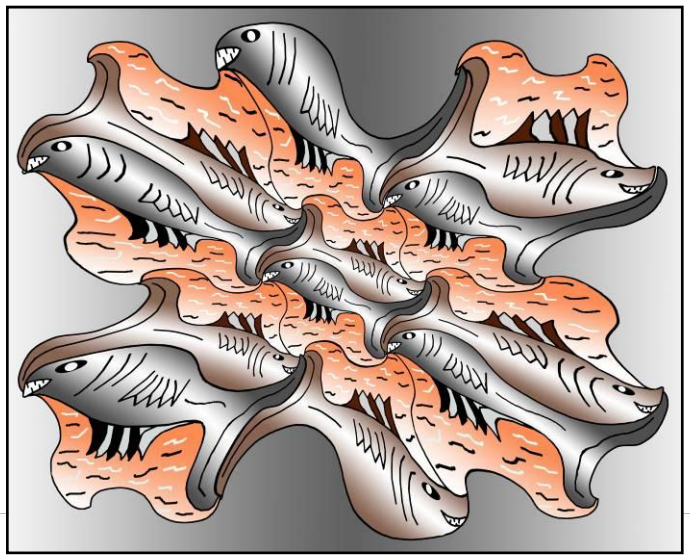


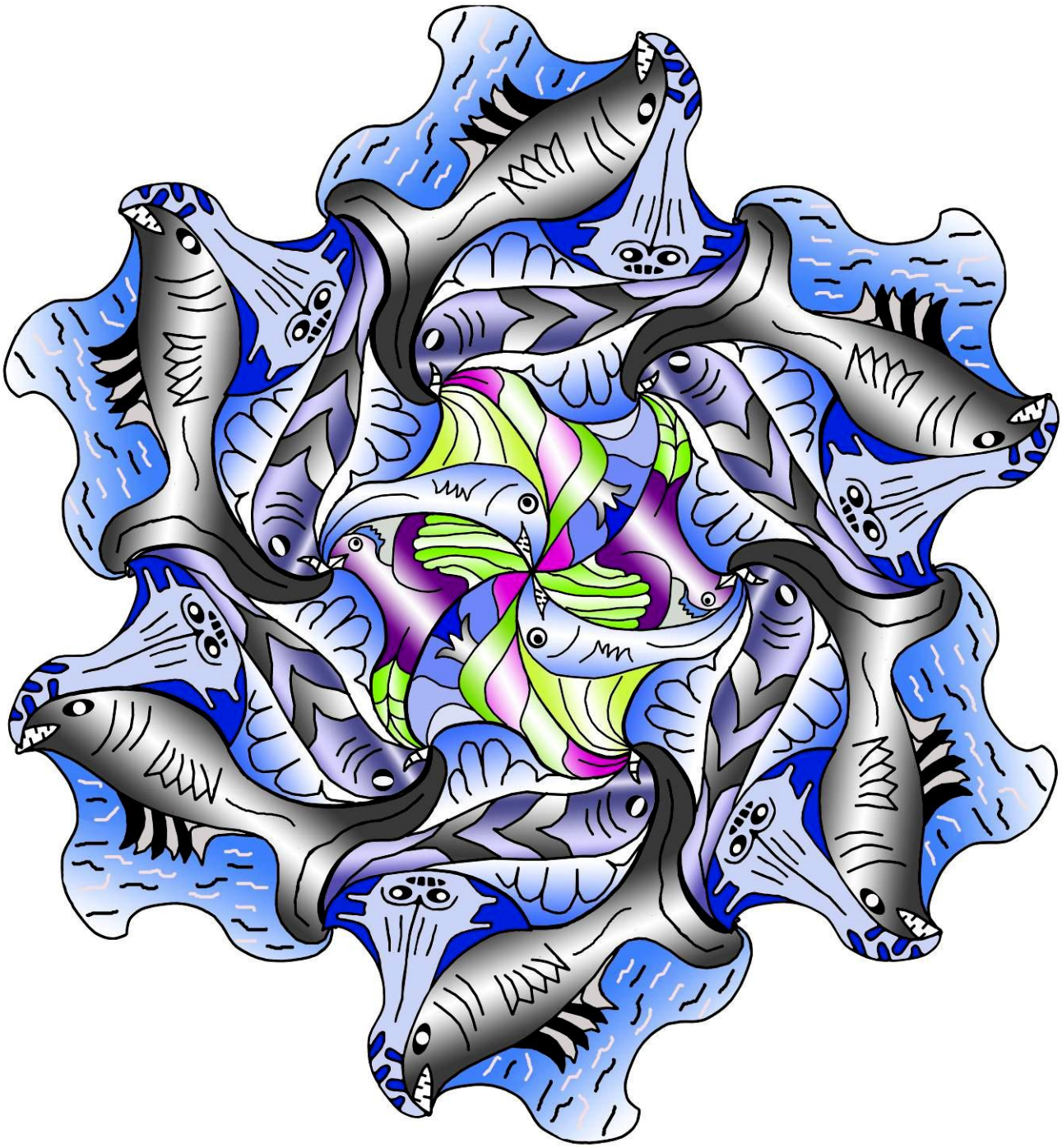




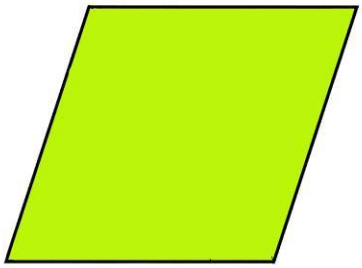


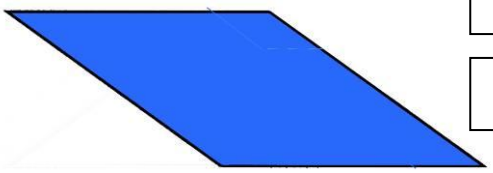






f) Pavages de type PENROSE :

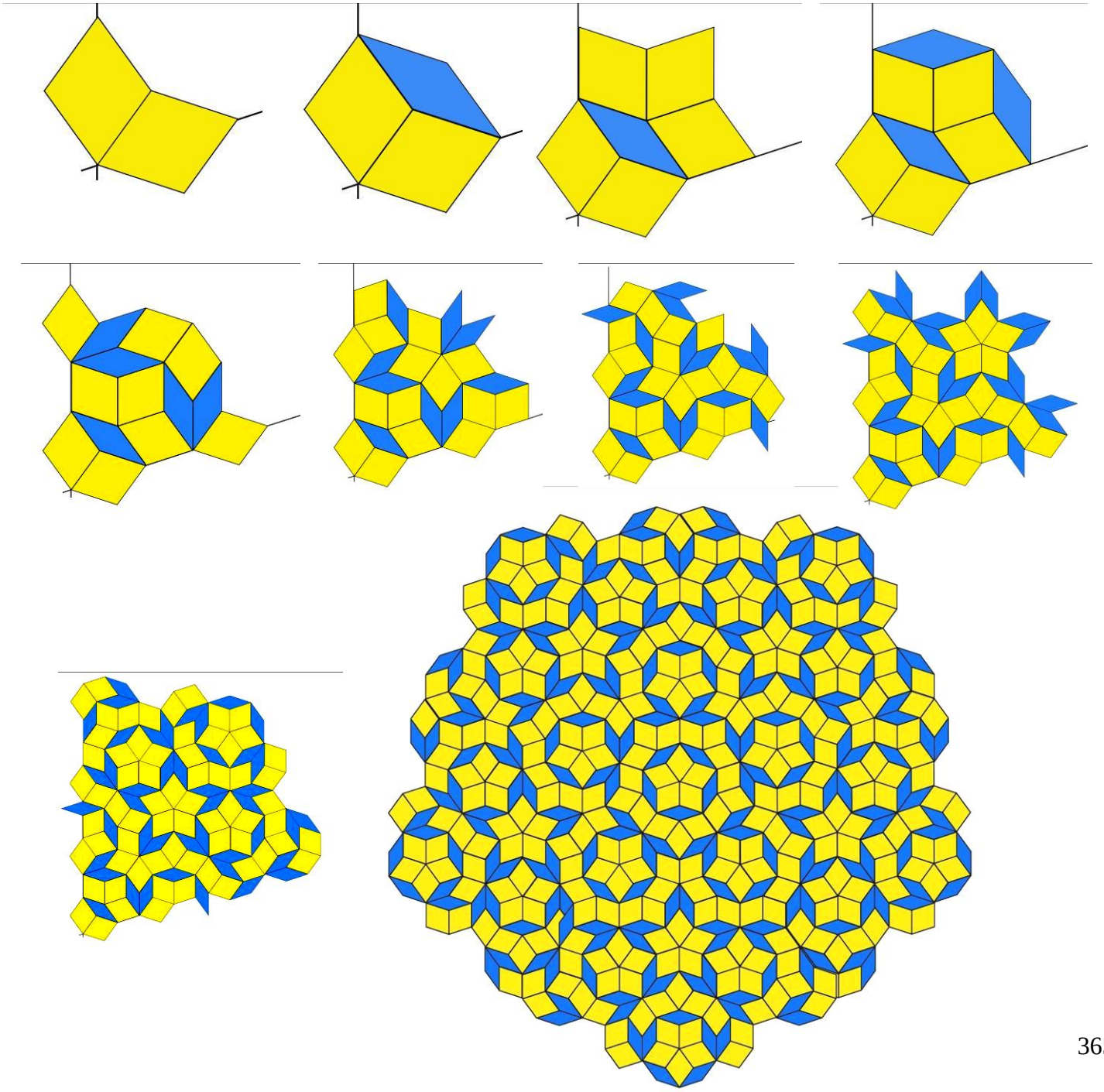


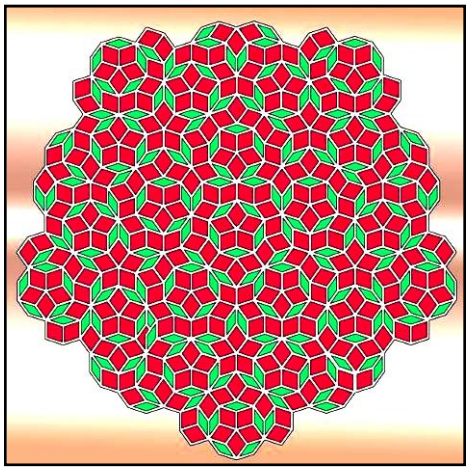


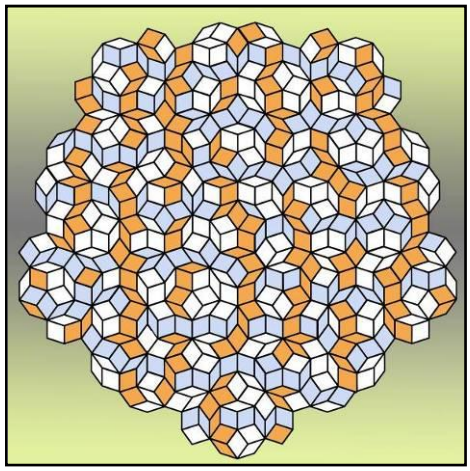
CONSTRUCTION

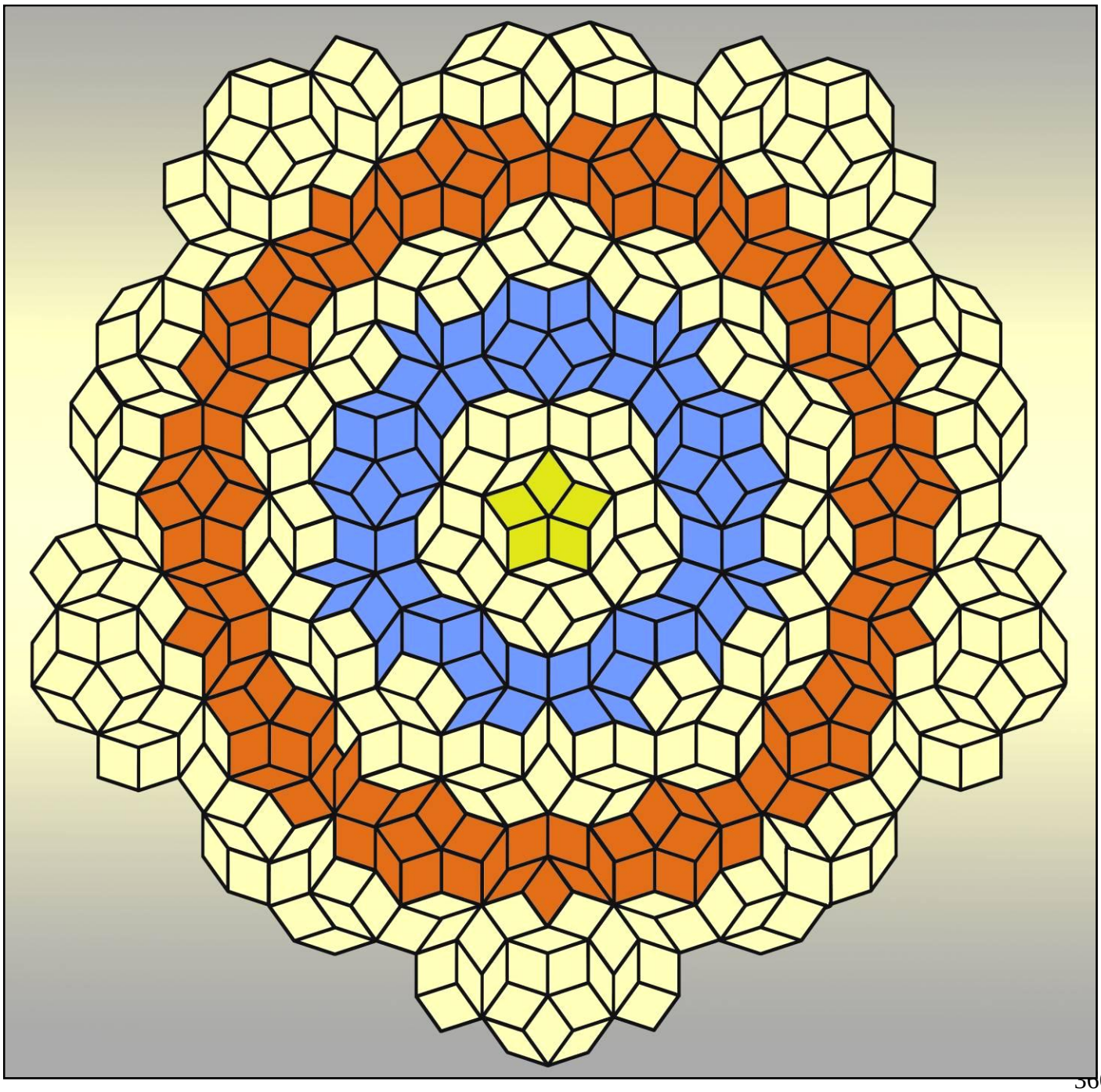
CONSTRUCTION

Deux pavés posés dans **un ordre bien déterminé** pavent tout le plan.

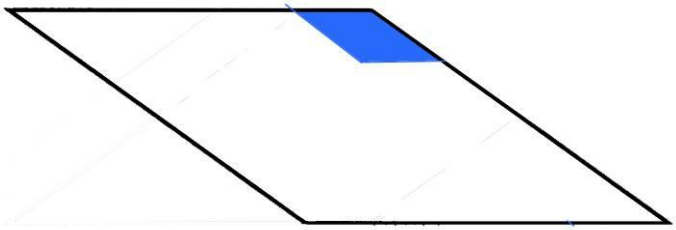


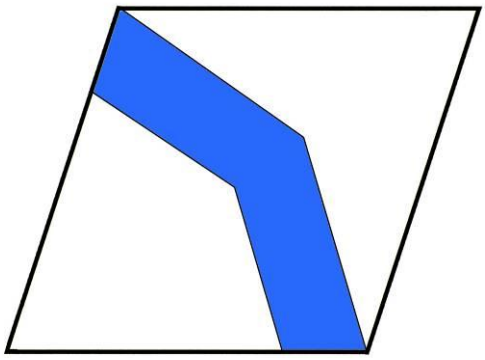


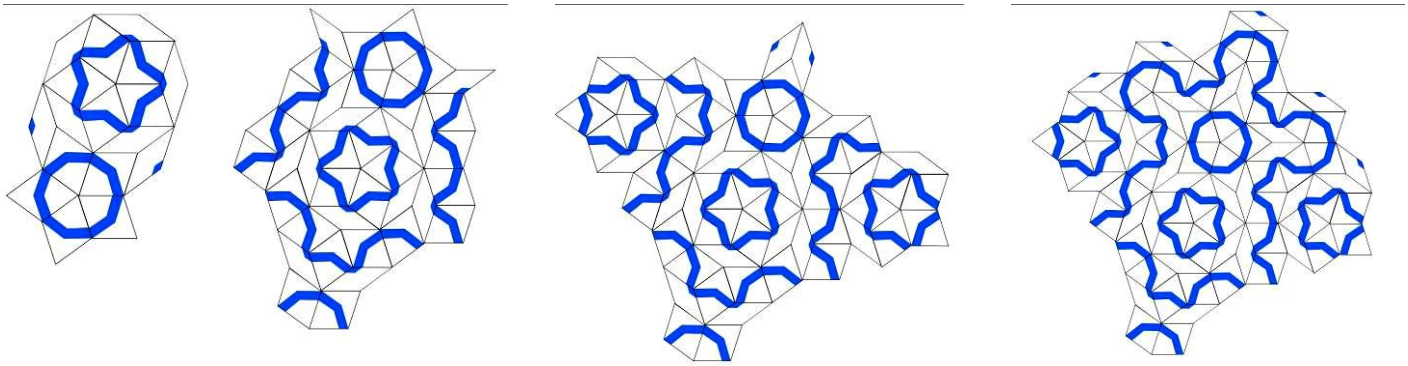




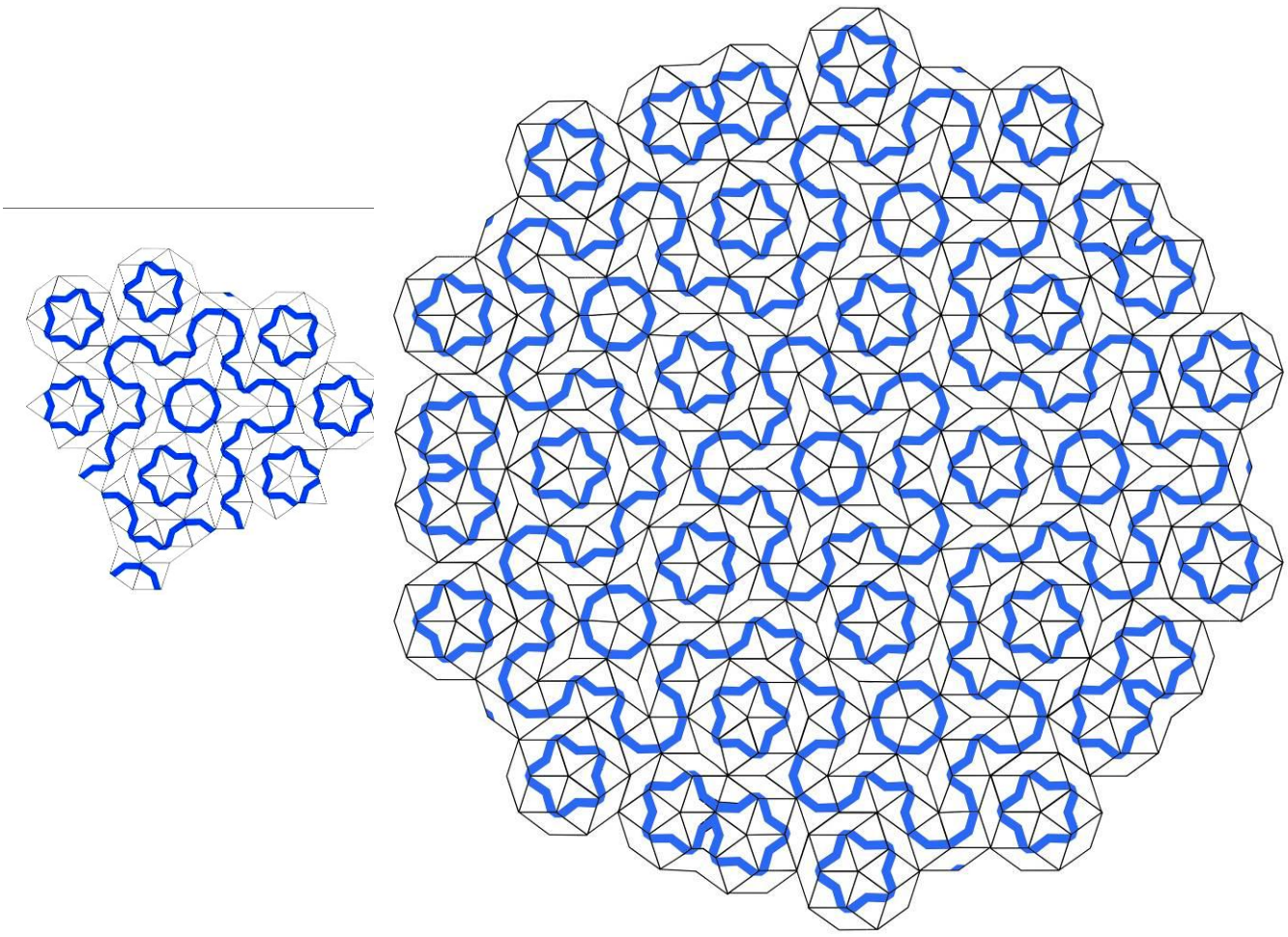
CONSTRUCTION

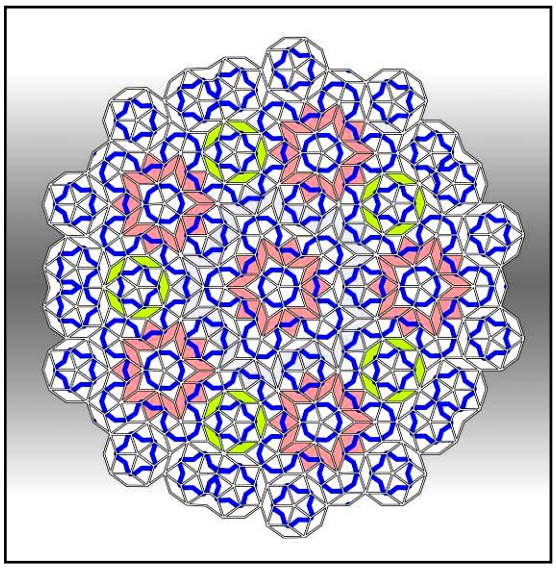


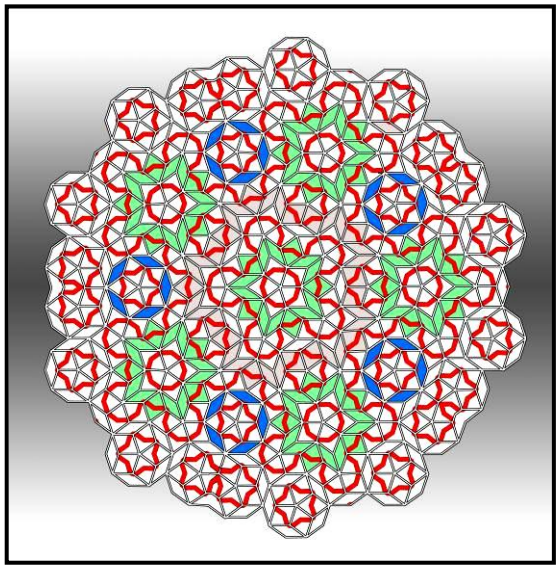


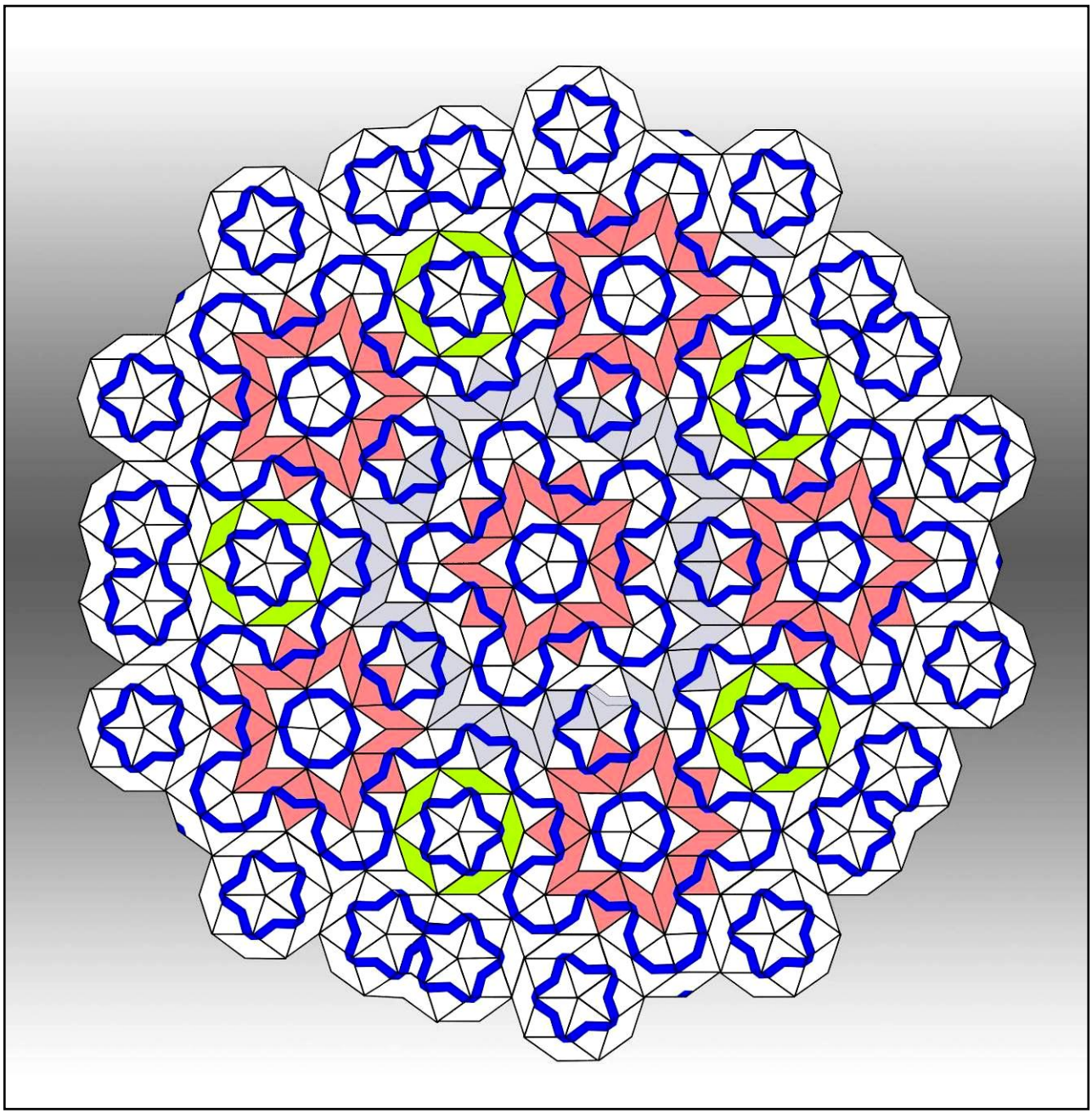


Règle : à la construction, les parties bleues ne doivent pas être isolées mais en contact.

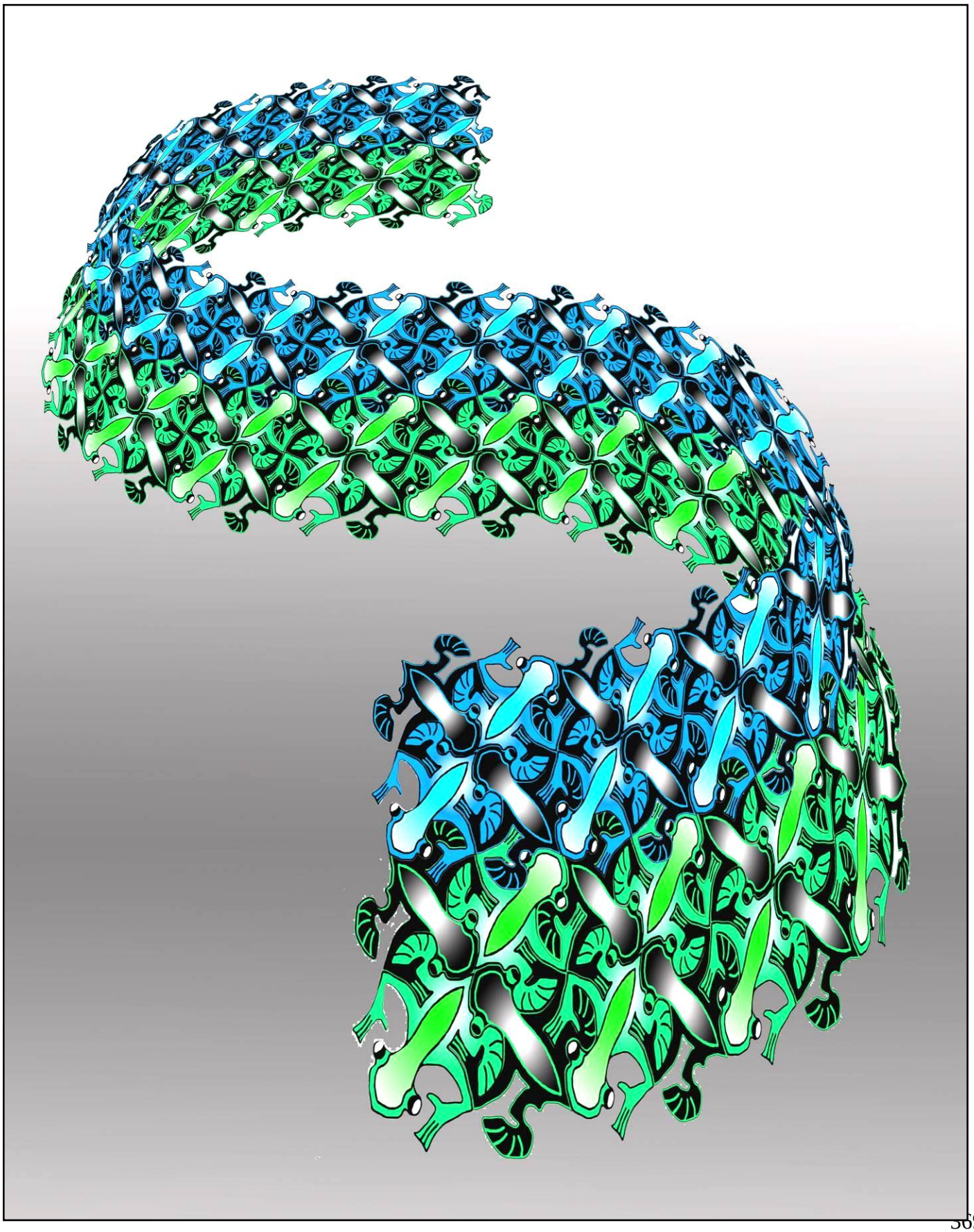


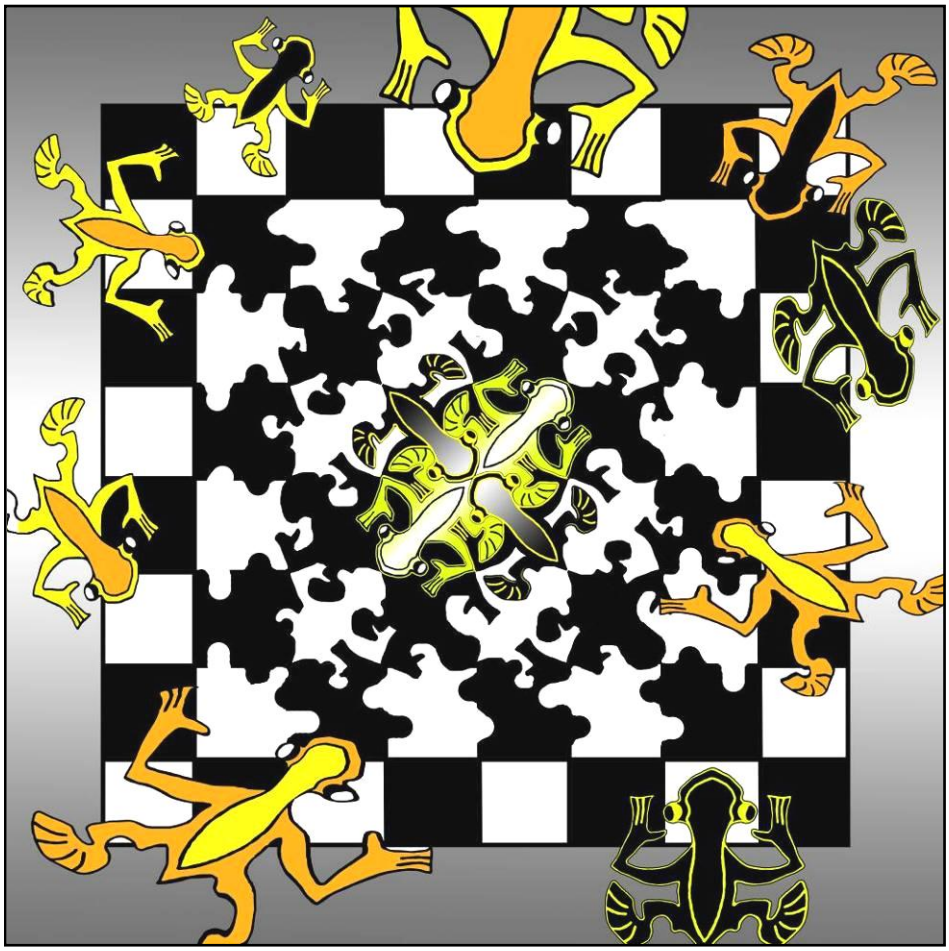


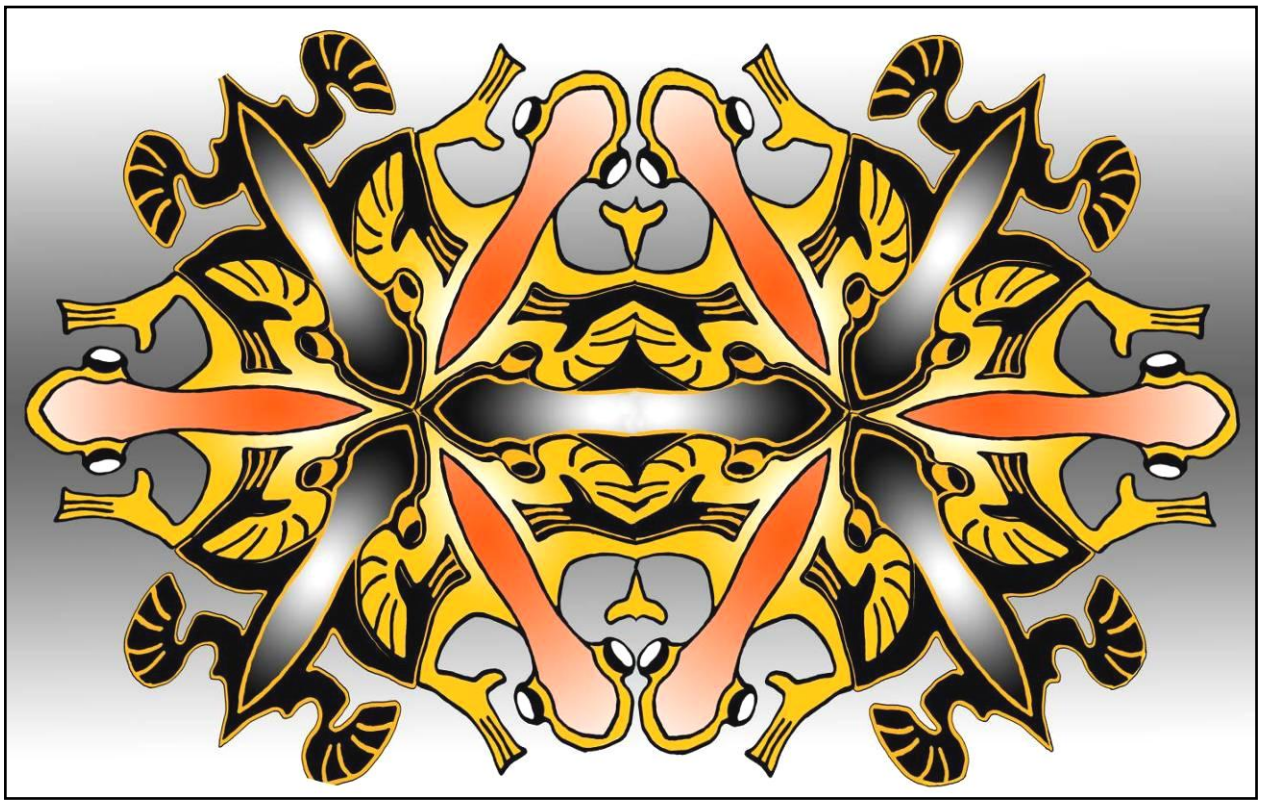




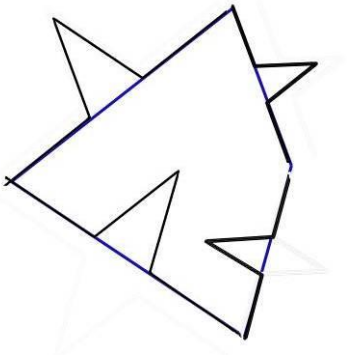
g) Autres constructions :

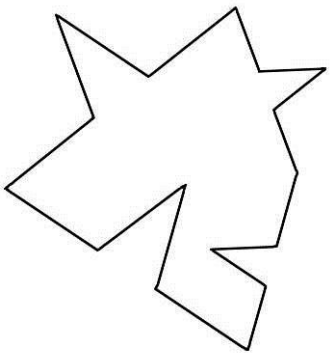


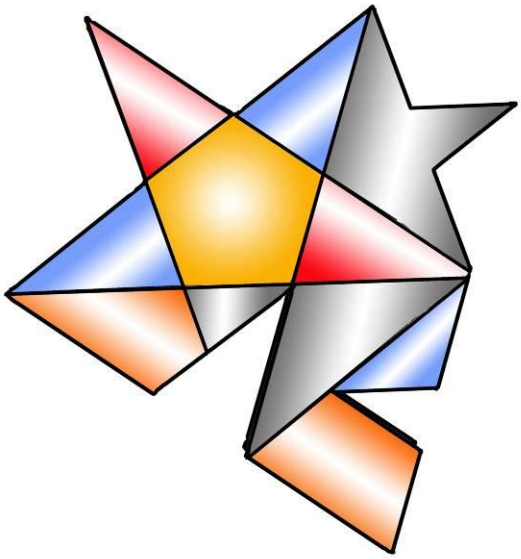


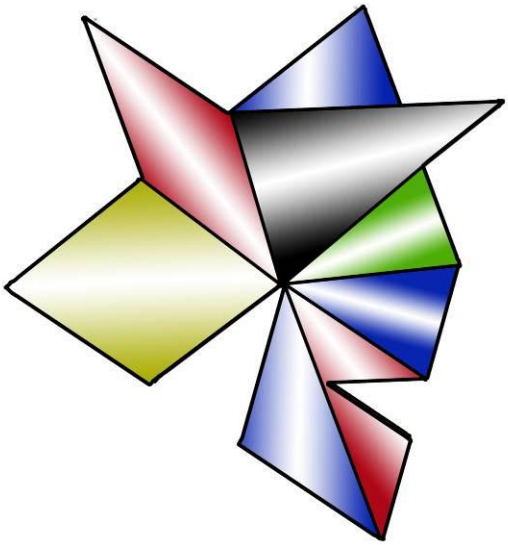


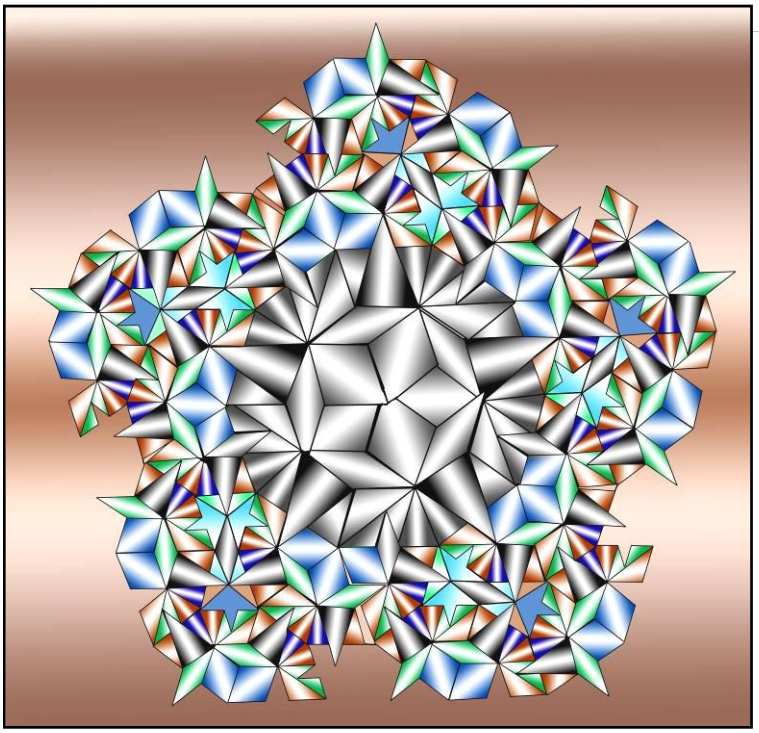
CONSTRUCTION

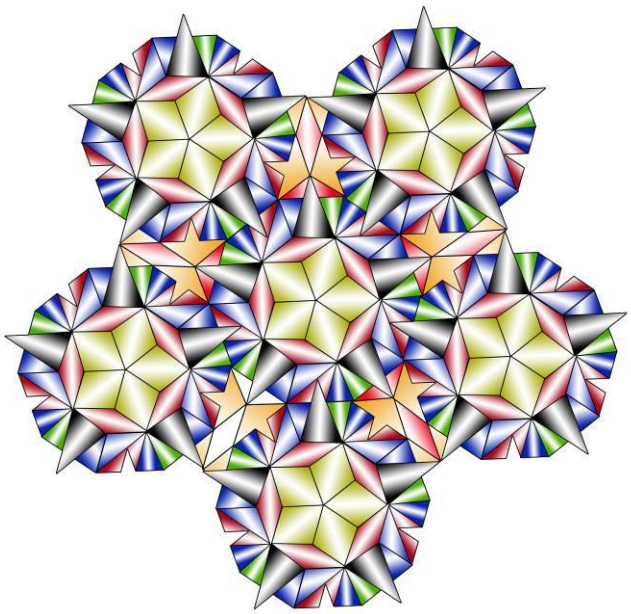












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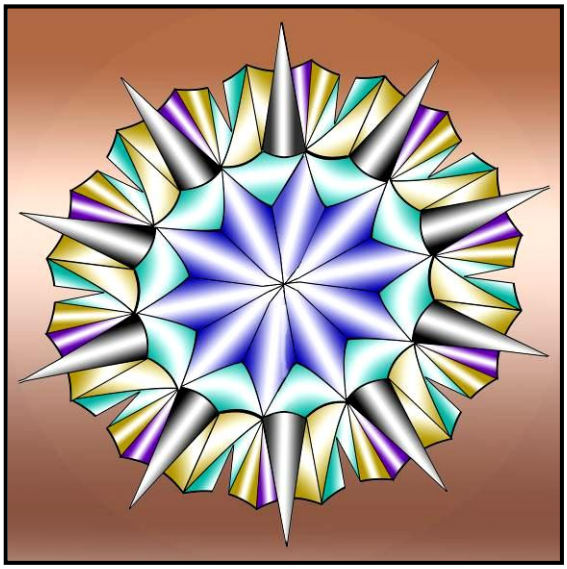
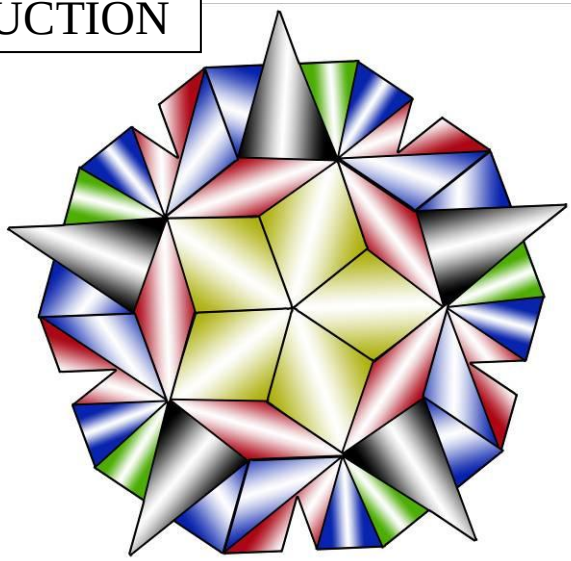
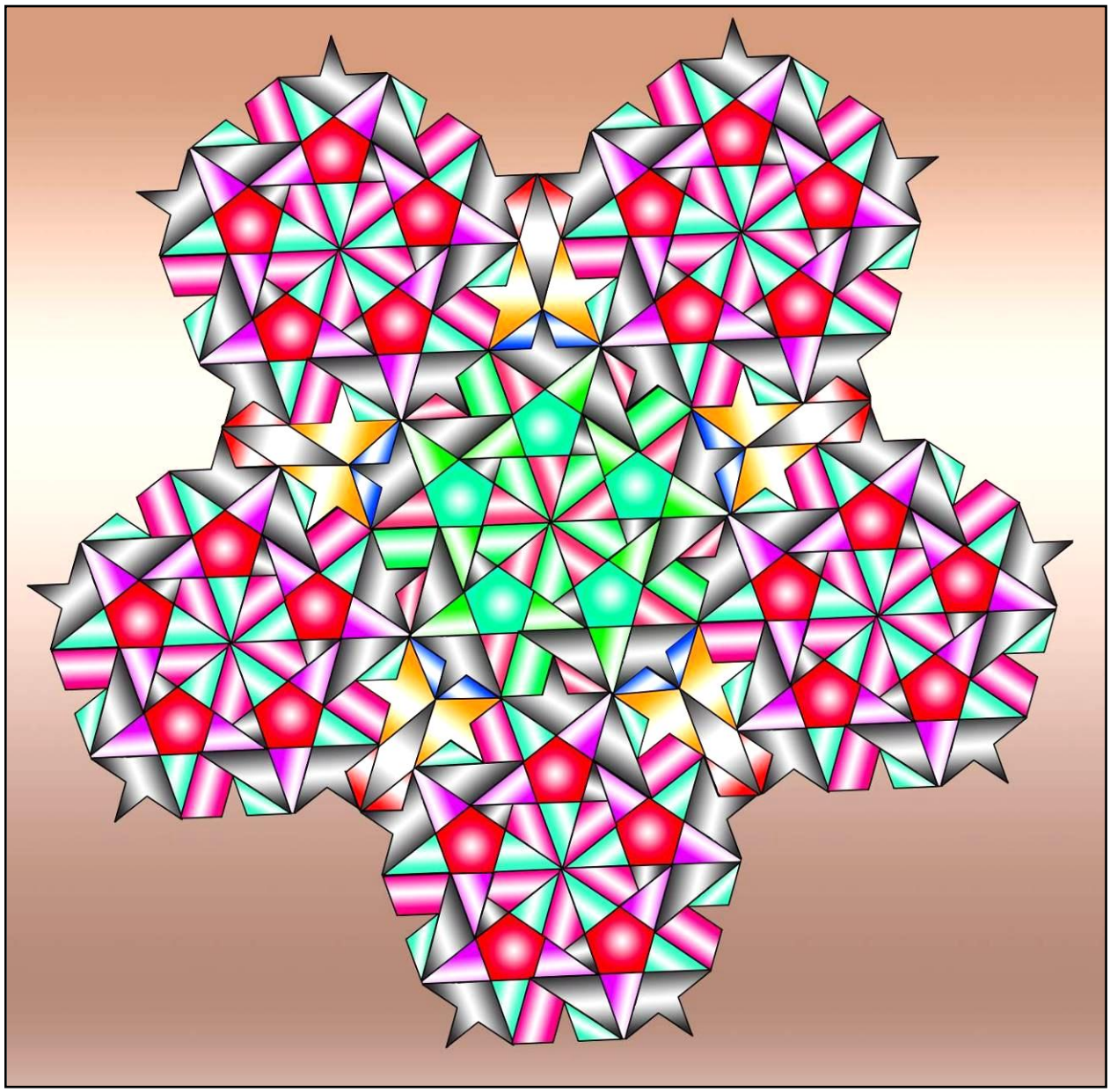
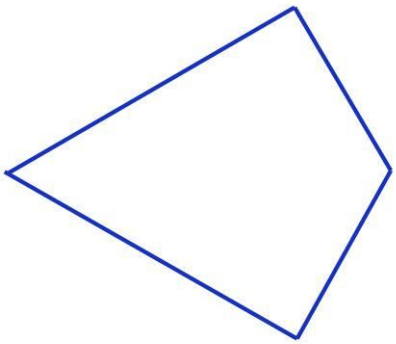
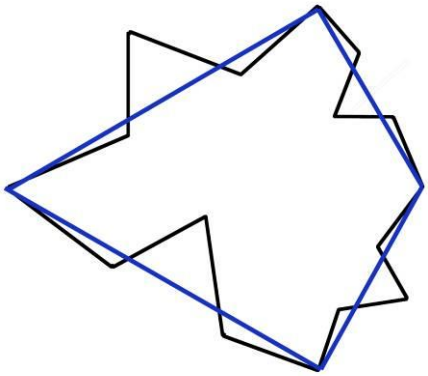
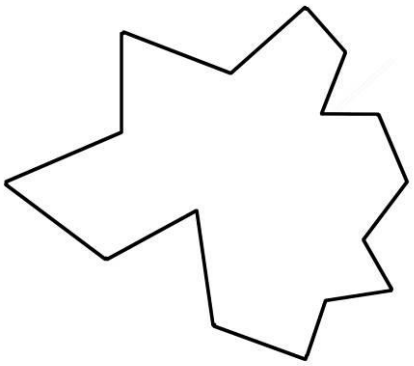


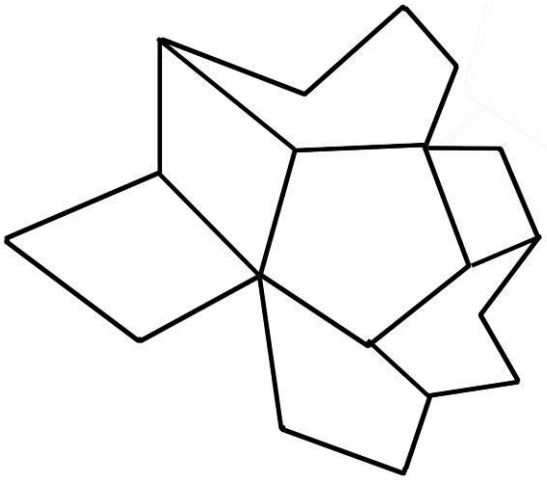


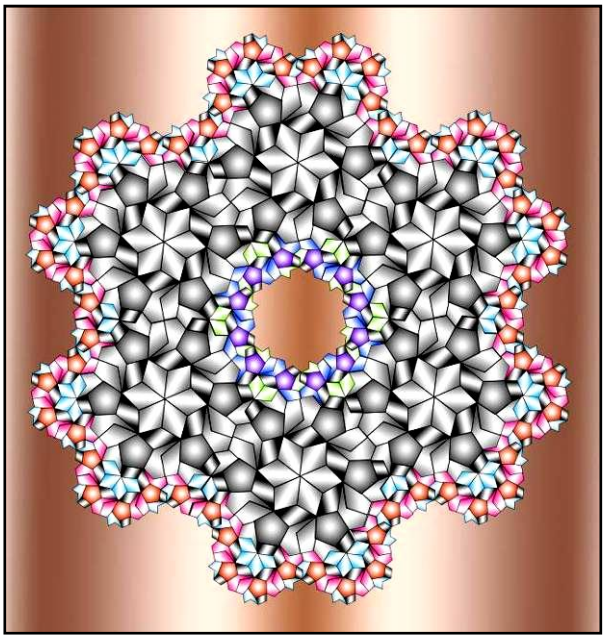


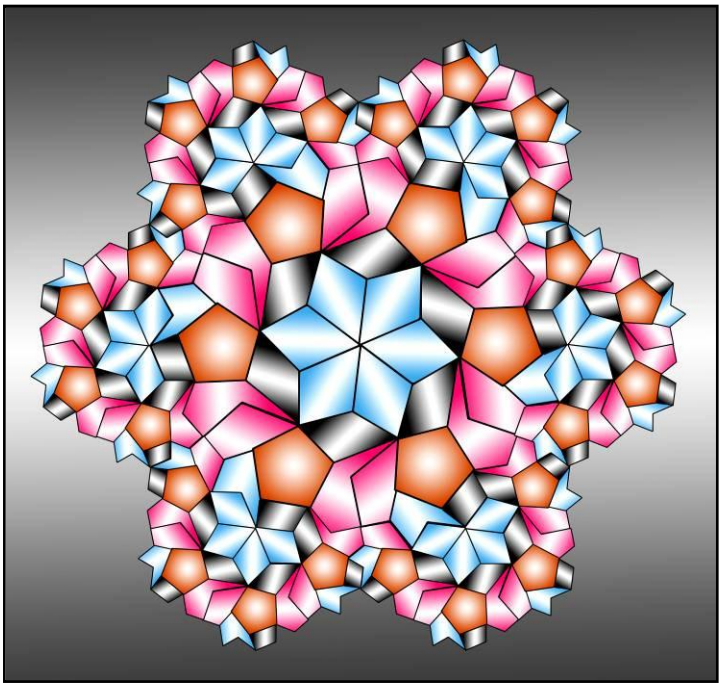


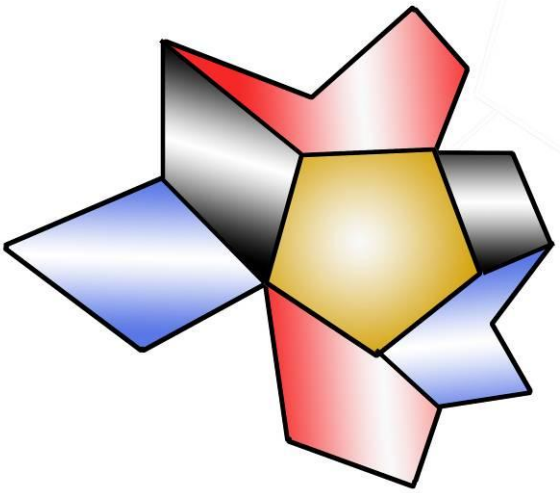


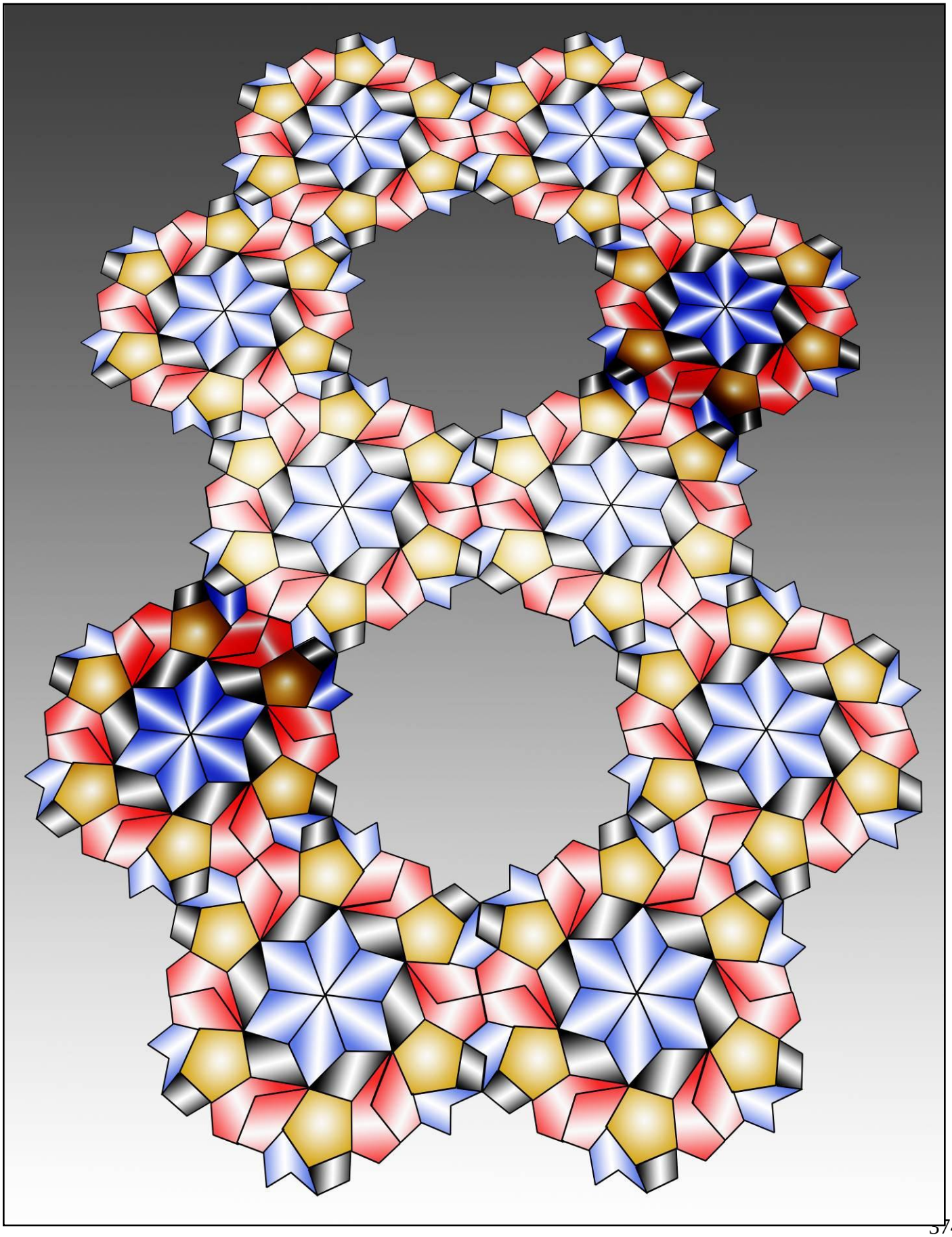




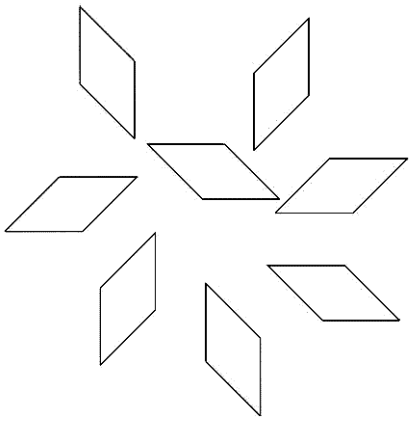


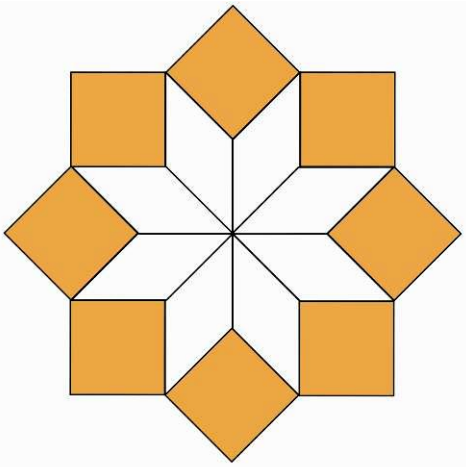


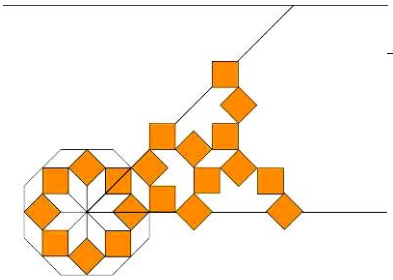


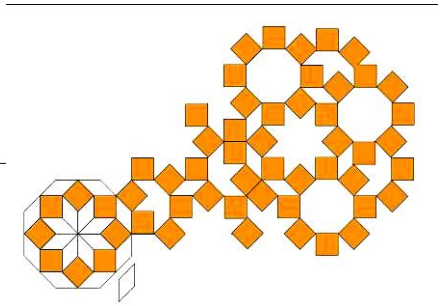


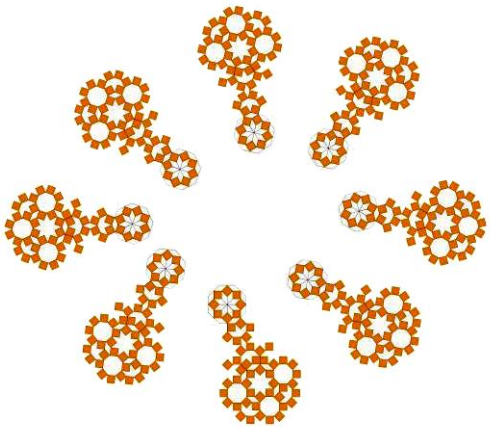
CONSTRUCTION

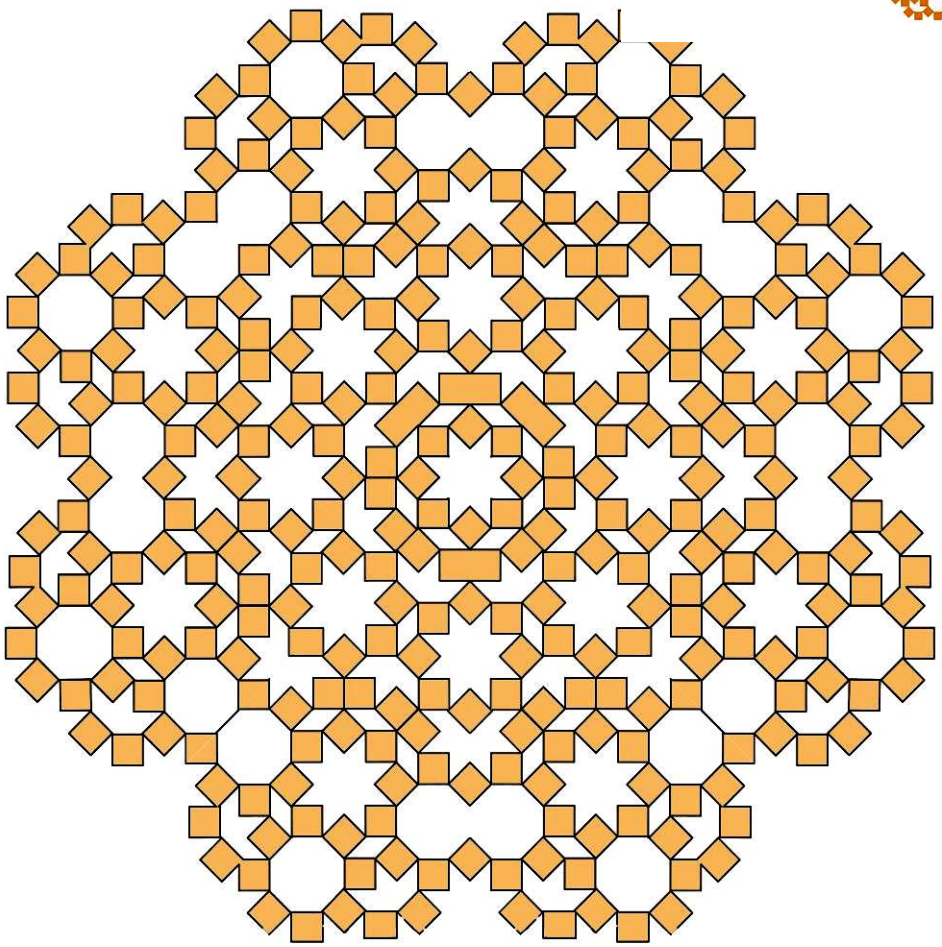


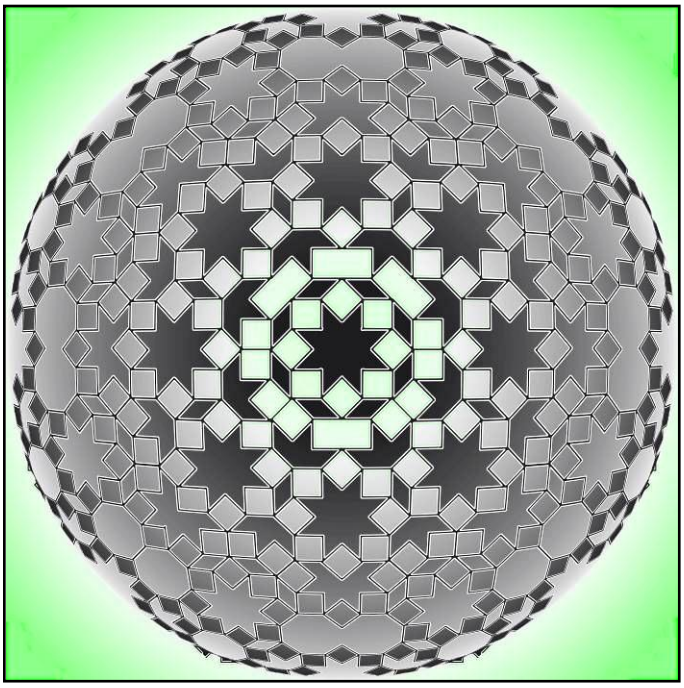


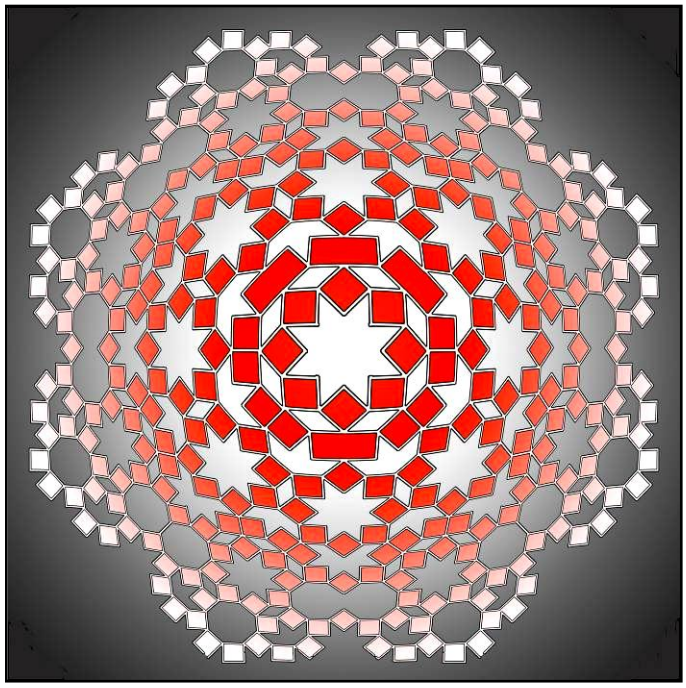


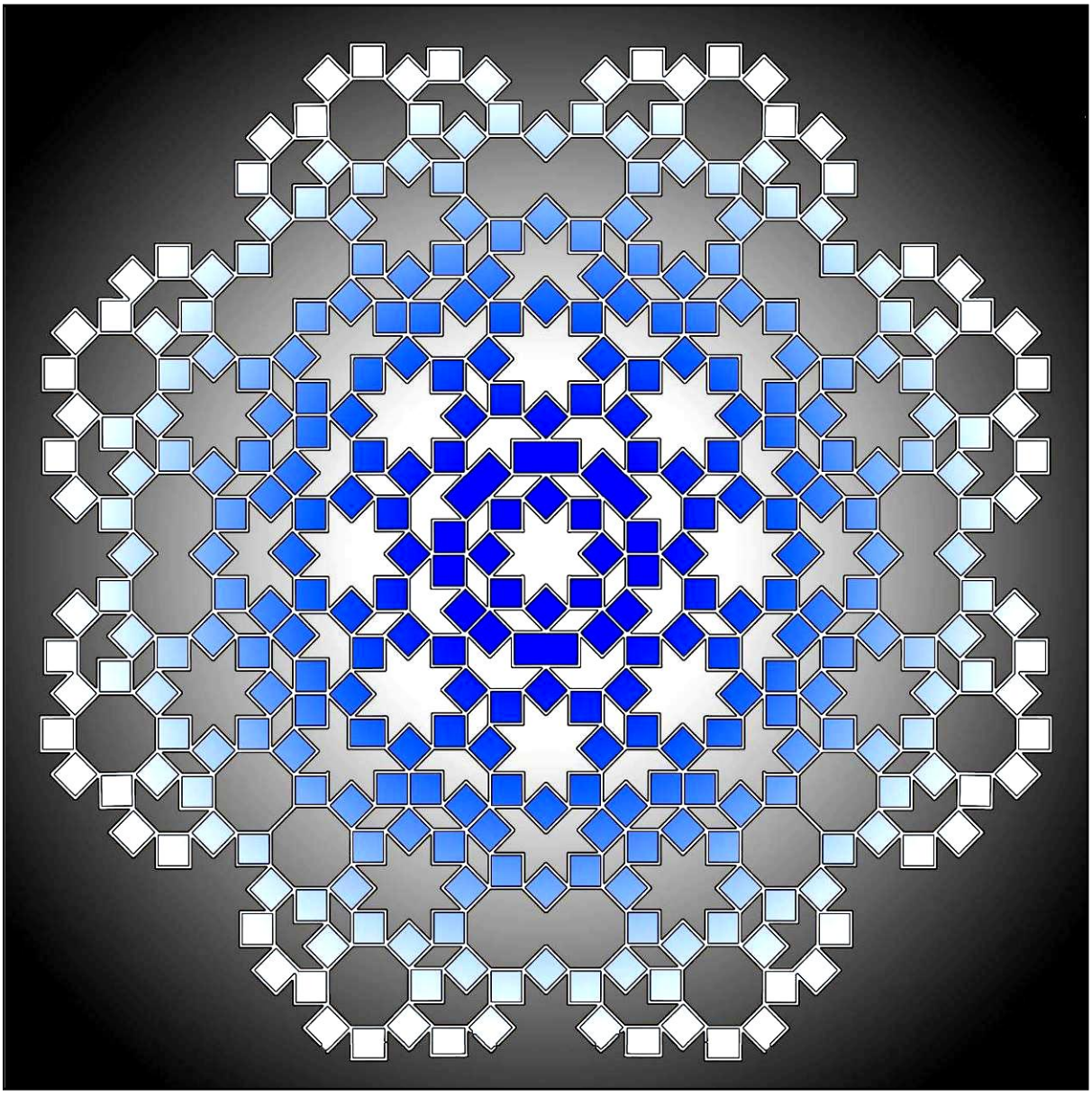












Consultez le site de l'auteur pour avoir accès à plus de 2000 photos haute résolution, près de 200 diaporamas ou vidéos et près de 200 constructions guidées, le tout agrémenté d'une musique orientale originale.

www.arabesquesgeometriques.fr/

CONTACTS

Dans le site précédent (arabesques géométriques), dans le bandeau du haut, cliquez sur « **C** » (votre avis) pour donner votre avis sur ce livre ou entrer en contact avec l'auteur.

RETOUR