CHAPTER - V

EVALUATION OF BIOLOGICAL AND PIGMENTATION PROPERTIES OF SCHIFF BASE COMPLEXES

CHAPTER - V

(A) Biological Activity :

A large number of Quinoline derivatives especially where the methyl or a methoxy substituted is at the "8th" position are effective against microbial diseases. Misra and Saxena[1-2] have reported some quinolines having good activity against E.histolytica at a conc. 12.5 µg/ml. Also, a group of anils have shown good activity against E.Coli[3-4]. Albert and Magrath[5] have studied derivatives of 8-hydroxy quinolines as evidenced by their ability to combine with trace metals in neutral solution. 8-hydroxyquinoline alone, of the seven isomeric hydroxy quinolines possessed good chelating ability.

Philips and co-workers have examined a number of 2-substituted 8-hydroxyquinolines as well as their copper chelates. Synthesis and antibacterial activities of 8-thioglycolic hydrozones was carried out by Prakash[6]. The complexing behaviour of seventeen amino acid derivatives towards Cu(II) has been studied by Nandi and coworkers[7]. Biological activity of the complexes is more than that of the free metal ion and the ligands.

1. Experimental Work

Antifungal Activities of Mixed SB Complexes of Cu(II) Ni(II) and Zn(II) [TABLE 5.1 to 5.2]

Pucinia recondita and Alternaria Triticinia as test organisms for Antifungal activities were used.

This was carried out by using Agar plate technique in PDA media.

Composition of PDA media :

6.7 gm potatoes powder

2.0 gm dextrose

1.0 gm Agar

pH 5-6

100 ml distilled water

(Readymade powder (PDA) can be used, manufactured by HIMEDIA, Bombay).

Above media was used to grow the fungus,

Detail method.

(1) Above test organism was grown on PDA slants for 72 hrs. at 30°C.

(2) Spore suspension of this fungus was made in distilled water containing 0.1 % (w/w) Tween 80. (polyoxyethylene Sorbitan monooleate).

(3) PDA plates were prepared.

(4) For making spore suspension, 5 ml of 0.1% Tween 80 was added to each slant and the spores were brought into suspension by scraping the surfae of the culture gently.

(5) 0.5 ml of this spore suspension was spread on PDA plate and the plates were allowed to dry at 30°C for about 1 hr.

(6) Three holes (5 mm diam) were punched and the agar plugs were removed in each plates by the help of a sterile glass tube at equidistance in a triangular fashion.

(7) The Schiff base complexes were dissolved in DMF or Acetone at a concentration of 50 μg/ml .

(8) 1.0 ml of these solutions was added to each hole with sterile pipettes. Equal amount of DMF or Acetone was also tested as control.

(9) After addition of the Schiff base complexes solution plates were incubated for 72 hours at 30°C .

(10)The diameter of the inhibition zone was measured and recorded, activity was calculated by using equation.

$$\text{Activity \%} = \frac{(C - T)}{C} \times 100$$

where C = diameter of fungus colony of control

T = diameter of fungus colony of Mixed SB complexes

Anti-Bacterial Activities of Mixed Schiff base Complexes of Cu(II), Ni(ii) and Zn(II). [TABLE 5.1 to 5.2]

E.Coli (-ve) and staphylococcus coagulase (+ve) were used as test organisms for Antibacterial activities.

This was carried out by using total plate count method[8] in MaC Conkey and Nutrient media.

Composition of MaC Conkey media

Mac Conkey powder 5 gm

Bacto - agar 1.5 gm

100 ml distilled water

pH 6.8

Composition of Nutrient media

Pepetone 5 gm

Bacto-agar 1.5 gm

100 ml distilled water,

pH 6.8

MaC Conkey or peptone powder and Bacto - agar were dissolved in 100 ml distilled water,

(1) Pipettes and petridishes were sterilised in an autoclave at 115°C temp. and 1.5 kgs pressure for 20 minutes.

(2) Above test organisms were grown in MaC Conkey and Nutrient media on plates for 48 hours at 30°C.

activities. All the complexes mentioned in earlier chapters are biologically active. Some are more active and some are very less active. The activities of all the complexes are explained on some common concept of coordination. The Schiff base complexes of en, pn Aniline, and its derivatives have been studied with hydroxy aldehydes and ketones for their anti bacterial, antifungal activities. The organic Schiff bases are found to be more bioactive than free hydroxy aldehydes or ketones. More over the metal complexes are more active than free Schiff bases, and free metal ions. This is due to chelation which reduces considerably the polarity of the metal ion in thecomplexes. This reduction is due to balancing of repulsion between the ligand by the charge on the central metal ion. This may also be due to partial sharing of its positive charge with the donor groups and possible electron delocalisation over the whole chelate ring system through $d_{\pi} - d_{\pi}$ or $p_{\pi} - d_{\pi}$ interactions of the ligand orbital and the metal ion. This in turn increases the hydrophobic character of the metal chelate favouring its permeation through lipoid layers of test organism mebrane.

The biological activity showed a gradual change with structural changes in the complex molecule. The

(3) MaC Conkey and Nutrient agar plates were prepared in aseptic condition.

(4) The Schiff base complexes were dissolved in 50% DMF at a concentration 50 μg/ml .

(5) 1.0 ml of these solutions was added to each plates.

(6) After addition of the Schiff base complex solution the plates were incubated for 48 hours at 30°C.

(7) DMF was used as control.

(8) The number of colonies were counted in plates and recorded.

(9) The colour of colony was red in MaC Conkey media and yellowish in Nutrient agar media.

The results are shown in Table and for detail study of complexes see Section 3 and 4 .

Results and Discussion :

The fungicidal and bactericidal data presented (Table S-1-S-2) show the positive behaviour of biological

increase in the chain length did not show much changes in activities but the presence of halogen, naphthyl or methoxy group in compounds enhanced the activity which is in agreement with reported work[9]. The activity of schiff base of en, pn and aniline and its derivatives were compared, the order was found to be en > pn > p-pheny > Benzidine which shows that amino group linked with different chain length has different effect as the structural activity.

Regarding the presence of metal ions effect, Zn is more active than copper and copper is more bioactive than Ni which is also in agreement with the reported work[10].

The activity of the complexes is higher when heterocyclic ring and sulfur are present in the complex. The mixed Schiff base complexes are more toxic than bis Schiff base complexes. The complexes showed some selective activity. The complexes which showed good bactericidal or fungicidal activity against one type of organism may not be toxic for the other organisms.

The direct application of these complexes has some limitations because of their water insolubility. The mechanism of anti bacterial and anti fungal activity of the Schiff base complexes is different from antitumours.

(B) As Textile Pigment :

Textile printing, of pigments including metal powders and flock, is accomplished by mechanical fixation, in contrast to other methods of dyeing and printing, which are based on affinity of fiber for dyestuff. This fixation is effected by imbedding the metal or pigment in substances which coagulate on subsequent steaming, form insoluble films by evaporation of the solvent in which they are dissolved, dispersed or become insoluble on high temperature condensation polymerization.

When the number of electrons associated with the metallic atom in its combination with the azo compound is smaller than the number required for the stable complex (33 for chromium, 35 for copper, 36 for cobalt), it is coordinatively unsaturated. The compound makes up for this deficiency by the attachement of water molecules, ammonia molecules etc. In the preparation of metal - dye complexes in substance, water is available for this purpose, and in mordant dyeing, electron - donor groups in the protein cellulose molecule can attach themselves to the metallic atom to form a stable metal dye fiber complex.

Printing by using Metal Powder

The decoration of textiles with metal powder is a technique which has been known for a very long time. Although the style was never produced on a large scale, it has enjoyed periods of popularity. At first gold leaf was used. The cloth was impregneted with glue or gum solution and the gold leaf was imprinted thereupon with light pressure of blocks. Schule used gold and silver powders, which he painted on the fabrics with brushes, in 1960. This method was employed with considerable success by Kurrer in the printing plant of Schoepplex and Hart-mann in Aagsburg.

Metal powders have been applied by printing gelatin or the gelatin paint, while still wet, is dusted with gold silver powder by means of brushes, the fabric is then dried. The metal powder is mixed with the glue, sometimes with the addition of beeswax and block-printed on the fabric after which the cloth is dried, then rinsed 5 or 6 minutes in a solution of alum. Yates used tin powder pasted up with glue or varnish[11]. Albumen was used in France around 1844 for fixing pigments and metal powders. Various thick oil preparations such as resin, varnish and lacquer as well as rubber solutions

have been used to apply bronze powders[12]. By these methods, print can be made which are fast to cracking.

Some attempts have been made to attach gold silver on fabrics by chemical precipitation or by electrolysis at time of the French Revolution. In more recent times a method of condensing vaporized metals on cloth was attempted on nylon. The metal is vaporized by means of a hot point or torch flames, the vapors directed against the fabric, which is covered by a stencil. Metal powders can be applied by block, screen and spray printing and also by roller print machines, provided the engraving is sufficiently deep.

Azamethine Pigments

This class of pigments which all have the chromophore $>C = N$, is best considered in two distinct groups (1) pure organics and (2) metal complexes, since their properties vary considerably, most of the azamethines are yellow to greenish yellow, but there are a few reds.

The metal complexes tend to be unstable to acids, liberating the metal which can easily be

identified, thus giving an indication of this class of pigments. Again there is only a smaller number to consider and the IR spectra are easily recognized, but cannot be classified by characteristics peaks since the organic ligands can vary considerably. The existance of the metal complexes of 0-hydroxyazo compounds indicate the trans arrangement of the groups attached to the azo group.

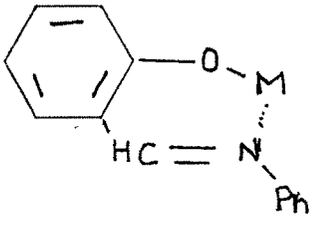

Fig. 5.1

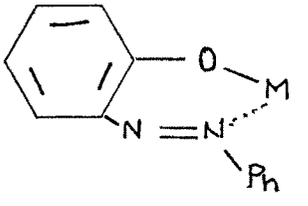

Fig. 5.2

By analogy with the metal derivative Fig. 5.1 of salicylideneaniline in which the coordination of the metal M and the nitrogen atom must result in a 6-membered chelate ring, the structure Fig. 5.2) for the metal complexes of 0-hydroxyazo dyes is generally assumed, but Fig. 5.1) and Fig. 5.2) are not strictly analogous, since the azomethine group has only one donor atom. Studies of the stereochemical properties of chelated compounds[13] have shown that 6-membered chelate ring possesses somewhat greater

stability than 5-membered rings and considerably more stable than 7-membered rings. The copper derivative of benzylidene-o-amino phenol as presumably having the structure Fig. (5.3), although a 6-membered ring structure Fig. 5.4 is not excluded[14].

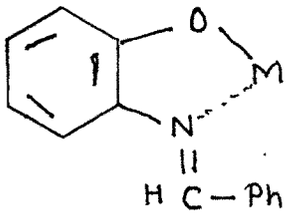

Fig. 5.3

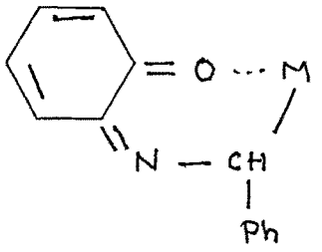

Fig. 5.4

Mixed Schiff base Complexes of Cu(II), Ni(II) or Zn(II) as textile Pigments : [TABLE 5.3 to 5.4]

Pigment properties study was done in emulsion paste.

Formulation of Paste

Acramin Binder SIN	15 ml
Kerosene	68 ml
Urea	5 gm

Ammonium chloride	2 gm
SB Complexes as pigment	2.0 gm

Procedure :

Acramin Binder SIN 15 ml was taken in porcelein pot and kerosene was slowly added with high speed stirring for 10 minutes than added urea and ammonium chloride, it was again stirred well for 10 minutes. Nearly 100 gm paste was obtained.

25 gm of paste and 0.5 gm Schiff base complexes were mixed and stirred well for 15 minutes at room temperature. Then screened it on cotton or silk or wool cloth. Dried the cloth in oven for 15-20 minutes at 115° - 120°C temperature, then washed it with plenty of water with rubbing and dried at 80°C. Washing, light and Rubbing fastness properties were measured using standard methods[15,16].

The light fastness study was carried out using Microseal light fastness tester having MBLV mercury lamp. Qualitative accessment is shown below :

Rating	Quality Accessment
8	Outstanding

Rating	Quality Accessment
7	Excellent
6	Very good
5	Good
4	Fairly good
3	Fair
2	Poor
1	Very poor

The washing fastness was done using Indian Standard method[16].

Rubbing (Cracking) dry and Wet fastness :

The specimens were fastned in the crackmeter with a piece of standard white cloth, (starch free 96x100 mm cotton fabric long type) and rubbed against the coloured specimen under control conditions of pressure and temperature.

Observation	Grade	Qualitative Accessment
No dye stain	5	Excellent
Slight dye stain	4	Very good
Moderate dye stain	3	Good
Distinct dye stain	2	Fair
Very much Distinct dye stain	1	Poor

The results were measured and recorded in Table No. Study of Schiff base complexes for perspiration fastness in acidic or basic condition is not possible because, Schiff base complexes dissociate in acidic or basic condition. The details study of complexes is given in Sections 3 and 4.

RESULTS AND DISCUSSION

The mechanism of printing is based on two main factgors :

(i) Binding between cellulose molecules and the complex compound.

(ii) Absorption of pigment on the fabrics.

(iii) Degree of saturation of the central metal atom by ligands.

Cellulose of cotton found to be less coordinating than the protein of woolen fibers containing $-NH_2$ or $-CONH_2$ group. Therefore cellulose metal complexes are less stable than the wool fiber metal complexes. Moreover due to presence of polar H_2O molecules in the complex it should be more stable on the cotton fabric containing cellulose, but due to presence of $>C = N$ it may be forming

a stronger and more stable constraint with woolen fabrics which results in the higher rubbing fastness of the complexes. (Rubbing fastness 5-6)

Benzidine > p-phenylenediamine > pn > en

In case of aniline S. B. complex and its derivatives it is observed that the stability of the pigment is higher than other complexes. The binuclear nature of anthranilic acid shows it more stable because of presence of two metal ions in the structure which will have higher binding tendency with the fabrics.

TABLE 5.1 Anti Microbial Activity

Part - A

Fungicidal and Bactericidal Activity data of Mixed Schiff bases and their metal complexes using Aliphatic diamines and Aromatic diamines

Type of compounds	Fungicidal Activity % Inhibition conc. 50 g/ml		Bactericidal Activity % Inhibition conc. 50 g/ml	
	Alter Triticinia	Pucinia recondita	E.Coli (-ve)	Staphylococcus coagulase (+ve)
Metal salts				
Cu Acetate	++++	++++	++++	++++
Ni Acetate	+++-	+++-	+++-	+++-
Zn Acetate	++++	++++	++++	++++
Fig. 3.1				
X=H, Y=H, R=$(CH_2)_2$-				
58 1. $C_{19}H_{17}O_2N_3$	++++	++++	++++	++++
a $[C_{19}H_{15}O_2N_3 \cdot 2H_2O]Ni$	*	*	++++	++++
b $[C_{19}H_{15}O_2N_3 \cdot 2H_2O]Cu$	*-	*+	+++	+++
c $[C_{19}H_{15}O_2N_3 \cdot 2H_2O]Zn$	*+	*+-	*+	*+

* = 50%, + = 10%, - = 5%

cont....

Table cont...

SB 2.	$X=CH_3$, $Y=H$, $R'=-(CH_2)_2-$				
	$C_{20}H_{19}O_2N_3$	++++	++++	++++	++++
a	$[C_{20}H_{17}O_2N_3 \cdot 2H_2O]Ni$	*	*+	*	*
b	$[C_{20}H_{17}O_2N_3 \cdot 2H_2O]Cu$	*+	*+	*+	*+
c	$[C_{20}H_{17}O_2N_3 \cdot 2H_2O]Zn$	*+-	*+	*+-	*+
SB 3.	$X=CH_3$, $Y=4\text{-}OH$, $R'=-(CH_2)_2-$				
	$C_{20}H_{19}O_3N_3$	++++	++++	++++	++++
a	$[C_{20}H_{17}O_3N_3 \cdot 2H_2O]Ni$	*	*	*	*
b	$[C_{20}H_{17}O_3N_3 \cdot 2H_2O]Cu$	*	*+	*-	*
c	$[C_{20}H_{17}O_3N_3 \cdot 2H_2O]Zn$	*+-	*-	*+-	*
SB 4.	$X=CH_3$, $Y=4\text{-}OCH_3$, $R'=-(CH_2)$				
	$C_{20}H_{21}O_3N_3$	++++	++++	++++	++++

cont....

Table cont...

a	$[C_{25}H_{20}ON_4Cl.2H_2O]Ni$	*-	*-	*	*
b	$[C_{25}H_{20}ON_4Cl.2H_2O]Cu$	*+	*+-	*+	*+-
c	$[C_{25}H_{20}ON_4Cl.2H_2O]Zn$	*++	*++	*++	*++

Fig. 3.1

SB 8 X=H, Y=H, $R' = -(CH_2)_3-$

$C_{20}H_{19}O_2N_3$

a	$[C_{20}H_{17}O_2N_3.2H_2O]Ni$	*+++	*+++	*+++	++++
b	$[C_{20}H_{17}O_2N_3.2H_2O]Cu$	*	*	*	++++
c	$[C_{20}H_{17}O_2N_3.2H_2O]Zn$	*+	*+	*+-	*+-

SB 9 $X=CH_3$, Y=H $R' = -(CH_2)_3-$

$C_{21}H_{21}O_2N_3$

a	$[C_{21}H_{19}O_2N_3.2H_2O]Ni$	*	*	*	*
b	$[C_{21}H_{19}O_2N_3.2H_2O]Cu$	*+	*-	*+	*+
c	$[C_{21}H_{19}O_2N_3.2H_2O]Zn$	*+-	*+-	*++	*++

SB 10 $X=CH_3$, Y=4-OH, $R' = -(CH_2)_3-$

$C_{21}H_{21}O_3N_3$

		-		-	
a	$[C_{21}H_{19}O_3N_3.2H_2O]Ni$	*	*	++++	*

cont...

Table cont...

	b	$[C_{21}H_{19}O_3N_3 \cdot 2H_2O]Cu$	*+	*+	*+	*-
	c	$[C_{21}H_{19}O_3N_3 \cdot 2H_2O]Zn$	*++	*+	*+-	*+-
SB	11	$X=CH_3$, $Y=4\text{-}OCH_3$, $R' = -(CH_2)_3-$				
		$C_{22}H_{23}O_3N_3$	+++	+++	+++	+++
	a	$[C_{22}H_{21}O_3N_3 \cdot 2H_2O]Ni$	*+	*+	*-	*+
	b	$[C_{22}H_{21}O_3N_3 \cdot 2H_2O]Cu$	*+-	*+-	*+-	*++
	c	$[C_{22}H_{21}O_3N_3 \cdot 2H_2O]Zn$	*++-	*++	*+++	*+++
		Fig. 3.2				
SB	12	$X=H$, $R' = -(CH_2)_3-$				
		$C_{24}H_{21}O_2N_3$	++	++	+++	+++
	a	$[C_{24}H_{19}O_2N_3 \cdot 2H_2O]Ni$	*	*	*	*-
	b	$[C_{24}H_{19}O_2N_3 \cdot 2H_2O]Cu$	*-	*+	*+	*+-
	c	$[C_{24}H_{19}O_2N_3 \cdot 2H_2O]Zn$	*+	*+-	*+-	*++
SB	13	$X=CH_3$, $R' = -(CH_2)_3-$				
		$C_{25}H_{23}O_2N_3$	+++	++	+++	+++
	a	$[C_{25}H_{21}O_2N_3 \cdot 2H_2O]Ni$	*	*	*	+++

cont...

Table cont...

b	$[C_{25}H_{21}O_2N_3 \cdot 2H_2O]Cu$	*-	*-	*+	*-
c	$[C_{25}H_{21}O_2N_3 \cdot 2H_2O]Zn$	*+-	*+	*+	*+

Fig. 3.3

SB 14 $X=C_6H_5$, $Y=5\text{-}Cl$, $R' = -(CH_2)_3-$

	$C_{26}H_{22}ON_4Cl$	*+++	*+++	*+++	*+++
a	$[C_{26}H_{20}ON_4Cl \cdot 2H_2O]Ni$	*+	*+	*-	*+
b	$[C_{26}H_{20}ON_4Cl \cdot 2H_2O]Cu$	*+-	*+-	*++	*++
c	$[C_{26}H_{20}ON_4Cl \cdot 2H_2O]Zn$	*+++	*++	**-	*+-

Fig. 3.4

SB 15 $X=H$, $Y=H$, $R' = -C_6H_4-$

	$C_{23}H_{19}O_2N_3$	++++	++++	++++	++++
a	$[C_{23}H_{17}O_2N_3 \cdot 2H_2ONi_2]$	*	++++	*	*
b	$[C_{23}H_{17}O_2N_3 \cdot 2H_2OCu_2]$	*-	*	*-	*-
c	$[C_{23}H_{17}O_2N_3 \cdot 2H_2OZn_2]$	*+	*-	*+	*+

SB 16 $X=CH_3$, $Y=H$, $R' = -C_6H_4-$

	$C_{24}H_{21}O_2N_3$	++++	++++	++++	++++
a	$[C_{24}H_{19}O_2N_3 \cdot 2H_2ONi_2]$	++++	++++	++++	++++

cont...

Table cont.

	b	$[C_{24}H_{19}O_2N_3 \cdot 2H_2OCu]_2$	*	*-	*-	*-
	c	$[C_{24}H_{19}O_2N_3 \cdot 2H_2OZn]_2$	*+	*-	*+	*+
SB	17	X=CH_3, Y=H-OH, R' = $-C_6H_5$				
		$C_{24}H_{21}O_3N_3$	++++	+++	++++	+++
	a	$[C_{24}H_{21}O_3N_3 \cdot 2H_2ONi]_2$	++++	+++	++++	++++
	b	$[C_{24}H_{19}O_3N_3 \cdot 2H_2OCu]_2$	*	*	*	*-
	c	$[C_{24}H_{19}O_3N_3 \cdot 2H_2OZn]_2$	*+	*+	*+	*++
SB	18	X=CH_3, Y=4-OCH_3 R' = $-C_6H_5$-				
		$C_{25}H_{23}O_3N_3$	++++	+++	++++	++++
	a	$[C_{25}H_{21}O_3N_3 \cdot 2H_2ONi]_2$	*	*	*-	*-
	b	$[C_{25}H_{21}O_3N_3 \cdot 2H_2OCu]_2$	*+	*+	*+	*+
	c	$[C_{25}H_{21}O_3N_3 \cdot 2H_2OZn]_2$	*+	*++	*+	*+

Table cont....

Fig. 3.5

SB	19	$X=H$, $R' = -C_6H_5-$				
		$C_{27}H_{21}O_2N_3$	+++	+++	+++	+++
	a	$[C_{27}H_{19}O_2N_3 \cdot 2H_2ONi_2]$	*	+++	+++	+++
	b	$[C_{27}H_{19}O_2N_3 \cdot 2H_2OCu_2]$	*	*	*-	*-
	c	$[C_{27}H_{19}O_2N_3 \cdot 2H_2OZn_2]$	*+	*+	*+	*+
SB	20	$X=CH_3$, $R' = -C_6H_5-$				
		$C_{28}H_{23}O_2N_3$	+++	+++	+++	+++
	a	$[C_{28}H_{21}O_2N_3 \cdot 2H_2ONi_2]$	*	+++	*	+++
	b	$[C_{28}H_{21}O_2N_3 \cdot 2H_2OCu_2]$	*-	*+	*-	*-
	c	$[C_{28}H_{21}O_2N_3 \cdot 2H_2OZn_2]$	*+	*+	*+	*+

Fig. 3.6

SB	21	$X=C_6H_5$, Y=5-Cl, $R' = -C_6H_5-$				
		$C_{29}H_{24}ON_4Cl$	+++	+++	+++	+++
	A	$[C_{29}H_{22}ON_4Cl \cdot 2H_2ONi_2]$	*+	*	*+	*-
	b	$[C_{29}H_{22}ON_4Cl \cdot 2H_2OCu_2]$	*+	*	*+	*-
	c	C_{29}				

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cont....

Table cont...

c	$[C_{29}H_{22}ON_4Cl.2H_2OZn_2]$	*++	*++	*++	*++

Fig. 3. 4

SB 22	X=H, Y=H, R' = $-C_6H_4-C_6H_4-$				
	$C_{29}H_{23}O_2N_3$	++++	+++*	+++*	++++
a	$[C_{29}H_{21}O_2N_3.2H_2ONi_2]$	++++	++++	++++	++++
b	$[C_{29}H_{21}O_2N_3.2H_2OCu_2]$	++++	*	*	*
c	$[C_{29}H_{21}O_2N_3.2H_2OZn_2]$	*-	*-	*-	*+
SB 23	X=CH_3, Y=H, R' = $-C_6H_4-C_6H_4-$				
	$C_{30}H_{23}O_2N_3$	++++	++++	+++*	++++
a	$[C_{30}H_{21}O_2N_3.2H_2ONi_2]$	++++	++++	++++	++++
b	$[C_{30}H_{21}O_2N_3.2H_2OCu_2]$	++++	++++	++++	++++
c	$[C_{30}H_{21}O_2N_3.2H_2OZn_2]$	*-	*-	*+	*+
SB 24	X=CH_3, Y=4-OH, R' = $-C_6H_4-C_6H_4-$				
	$C_{30}H_{25}O_3N_3$	++++	++++	++++	++++
a	$[C_{30}H_{23}O_3N_3.2H_2ONi_2]$	++++	++++	++++	++++

cont.....

Table cont....

b	$[C_{30}H_{23}O_3N_3 \cdot 2H_2OCu]_2$	*	*	*-	*-
c	$[C_{30}H_{23}O_3N_3 \cdot 2H_2OZn]_2$	*-	*-	*+	*+
SB 25	$X=CH_3$, $Y=4\text{-}OCH_3$ $R' = -C_6H_4-C_6H_4-$				
	$C_{31}H_{27}O_3N_3$	++++	++++	++++	++++
a	$[C_{31}H_{25}O_3N_3 \cdot 2H_2ONi]_2$	++++	++++	++++	++++
b	$[C_{31}H_{25}O_3N_3 \cdot 2H_2OCu]_2$	*-	*-	*+	*+
c	$[C_{31}H_{25}O_3N_3 \cdot 2H_2OZn]_2$	*-	*-	*+	*+
	Fig. 3.5				
SB 26	$X=H$, $R' = -C_6H_4-C_6H_4-$				
	$C_{33}H_{25}O_2N_3$	++++	++++	++++	++++
a	$[C_{33}H_{23}O_2N_3 \cdot 2H_2ONi]_2$	++++	++++	++++	++++
b	$[C_{33}H_{23}O_2N_3 \cdot 2H_2OCu]_2$	*	*	*	*
c	$[C_{33}H_{23}O_2N_3 \cdot 2H_2OZn]_2$	*-	*+	*+	*+
SB 27	$X=CH_3$, $R' = -C_6H_4-C_6H_4-$				
	$C_{34}H_{27}O_2N_3$	++++	++++	++++	++++

CONT....

Table cont....

a	$[C_{34}H_{25}O_2N_3 \cdot 2H_2ONi]_2$	++-+	++++	++++	++++
b	$[C_{34}H_{25}O_2N_3 \cdot 2H_2OCu]_2$	*	*	*-	*
c	$[C_{34}H_{25}O_2N_3 \cdot 2H_2OCu]_2$	*-	*+	*+	*+

Fig. 3.6

SB 28 $X=C_6H_5$, $Y=5\text{-}Cl$,
$R' = -C_6H_4\text{-}C_6H_4-$

	$C_{35}H_{28}ON_4Cl$	++++	++++	++++	++++
a	$[C_{35}H_{26}ON_4Cl \cdot 2H_2ONi]_2$	*-	*	*-	*-
b	$[C_{35}H_{26}ON_4Cl \cdot 2H_2OCu]_2$	*+	*+	*+	*+
c	$[C_{35}H_{26}ON_4Cl \cdot 2H_2OZn]_2$	*++	*+-	*++	*++

TABLE - S.2

Part - A

Fungicidal and Bactericidal Activity data of Mixed Schiff base Complexes derived from Aromatic amines

Type of Compounds	Antibacterial activity		Anti Fungal activity	
	Alter triti cinia	Puccinia recondita	E.coli (-ve)	Staphylococus coagulase (+ve)
Fig. 4.5				
MSB 1 X=H, Y=H, R=C_6H_5				
a $[C_{29}H_{21}N_3O_2 \cdot 2H_2O]Ni$	*	*	*	*
b $[C_{29}H_{21}N_3O_2 \cdot 2H_2O]Cu$	*-	*-	*-	*+
c $[C_{29}H_{21}N_3O_2 \cdot 2H_2O]Zn$	*+	*+	*+-	*+-
MSB 2 X=H, Y=H, R=$C_6H_4 2CH_3$				
a $[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Ni$	*	*	*	*
b $[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Cu$	*-	*+	*+	*-
c $[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Zn$	*+-	*+-	*+-	*+-

cont...

Table cont....

MSB 3	X=H, Y=H, $R=C_6H_4CH_3$				
a	$[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Ni$	*+	*+	*+	*+
b	$[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Cu$	*+	*+	*+	*+
c	$[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Zn$	*++	*++	*++	*++
MSB 4	X=H, Y=H, $R=C_5H_4N$				
a	$[C_{27}H_{19}N_5O_2 \cdot 2H_2O]Ni$	*+	*+	*+	*++
b	$[C_{27}H_{19}N_5O_2 \cdot 2H_2O]Cu$	*+	*++	*++	*++
c	$[C_{27}H_{19}N_5O_2 \cdot 2H_2O]Zn$	*++	*++	*++	*++
MSB 5	X=H, Y=H, $R=C_4H_3S$				
a	$[C_{25}H_{17}N_3O_2S_2 \cdot 2H_2O]Ni$	*++	*++	*++	*++
b	$[C_{25}H_{17}N_3O_2S_2 \cdot 2H_2O]Cu$	*++	*++	*++	*++
c	$[C_{25}H_{17}N_3O_2S_2 \cdot 2H_2O]Zn$	*+++	*+++	*++	*+++

Fig. 4.8

MSB 6	X=H, Y=H, $R=C_6H_4COOH$				
a	$[C_{31}H_{19}N_3O_6Ni_2]$	*+	*+	*+	*+

cont...

Table cont...

b	$[C_{31}H_{19}N_3O_6Cu_2]$	*+	*+	*+	*+-
c	$[C_{31}H_{19}N_3O_6Zn_2]$	*+-	*++	*++	*++

Fig. 4.5

MSB 7 $X=CH_3$, $Y=H$, $R=C_6H_5$

a	$[C_{30}H_{23}N_3O_2 \cdot 2H_2O]Ni$	*-	*-	*	*-
b	$[C_{30}H_{23}N_3O_2 \cdot 2H_2O]Cu$	*-	*+	*-	*+
c	$[C_{30}H_{23}N_3O_2 \cdot 2H_2O]Zn$	*+	*+-	*+	*++

MSB 8 $X=CH_3$, $Y=H$, $R=C_6H_42CH_3$

a	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Ni$	*	*	*	*-
b	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Cu$	*-	*-	*-	*+
c	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Zn$	*+-	*+	*+	*+-

MSB 9. $X=CH_3$, $Y=H$, $R=C_6H_44CH_3$

a	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Ni$	*	*	*	*
b	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Cu$	*-	*-	*-	*+

cont.

Table cont..

c	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Zn$	*+	*+	*+	*+-
MSB 10	X=CH_3, Y=H, R=C_5H_4N				
a	$[C_{28}H_{21}N_5O_2 \cdot 2H_2O]Ni$	*+	*+	*+	*+
b	$[C_{28}H_{21}N_5O_2 \cdot 2H_2O]Cu$	*+	*+-	*+-	*++
c	$[C_{28}H_{21}N_5O_2 \cdot 2H_2O]Zn$	*++	*++	*++-	*++-
MSB 11	X=CH_3, Y=H, R=C_4H_3S				
a	$[C_{26}H_{19}N_3O_2S_2 \cdot 2H_2O]Ni$	*++	*+-	*++	*++
b	$[C_{26}H_{19}N_3O_2S_2 \cdot 2H_2O]Cu$	*+-	*++	*++	*++
c	$[C_{26}H_{19}N_3O_2S_2 \cdot 2H_2O]Zn$	*++-	*++-	*+++	*+++

Fig. 4.8

MSB 12	X=CH_3, Y=H, R=C_6H_4COOH				
a	$[C_{32}H_{21}N_3O_6Ni_2]$	*+	*+	*+	*+-
b	$[C_{32}H_{21}N_3O_6Cu_2]$	*+	*+-	*+-	*+-
c	$[C_{32}H_{21}N_3O_6Zn_2]$	*++	*++	*++	*++-

cont...

Table cont...

Fig. 4.5

MSB 13		$X=CH_3$, $Y=4\text{-}OH$, $R=C_6H_5$				
	a	$[C_{30}H_{23}N_3O_3 \cdot 2H_2O]Ni$	*	*	++++	++++
	b	$[C_{30}H_{23}N_3O_3 \cdot 2H_2O]Cu$	*-	*-	*+	*+
	c	$[C_{30}H_{23}N_3O_3 \cdot 2H_2O]Zn$	*+-	*+	*++	*++
MSB 14		$X=CH_3$, $Y=4\text{-}OH$, $R=C_6H_42CH_3$				
	a	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Ni$	*	*	*	*
	b	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Cu$	*-	*-	*-	*
	c	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Zn$	*+	*+	*+	*+
MSB 15		$X=CH_3$, $Y=4\text{-}OH$, $R=C_6H_44CH_3$				
	a	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Ni$	*	*	*	*
	b	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Cu$	*	*-	*	*-
	c	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Zn$	*+	*+-	*+	*+

cont..

Table cont...

MSB 16 $X=CH_3$, $Y=4\text{-}OH$, $R=C_5H_4N$

a	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Ni$	*+	*+-	*-	*+
b	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Cu$	*+	*+-	*+-	*+-
c	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Zn$	*++	*++	*++	*++

MSB 17 $X=CH_3$, $Y=4\text{-}OH$, $R=C_4H_3S$

a	$[C_{20}H_{19}N_3O_3S_2 \cdot 2H_2O]Ni$	*+	*+	*+	*+
b	$[C_{20}H_{19}N_3O_3S_2 \cdot 2H_2O]Cu$	*+-	*+-	*+-	*+-
c	$[C_{20}H_{19}N_3O_3S_2 \cdot 2H_2O]Zn$	*++	*++	*++	*++

Fig. 4.8

MSB 18 $X=CH_3$, $Y=4\text{-}OH$, $R=C_6H_4COOH$

a	$[C_{32}H_{21}N_3O_7Ni_2]$	*+	*+	*+	*+
b	$[C_{32}H_{21}N_3O_7Cu_2]$	*+-	*+-	*+-	*+-
c	$[C_{32}H_{21}N_3O_7Zn_2]$	*++	*++	*++	*++

cont...

Table cont...

Fig. 4.5

MSB 19	$X=CH_3$, $Y=4-OCH_3$, $R=C_6H_5$				
	a $[C_{31}H_{25}N_3O_3 \cdot 2H_2O]Ni$	*	*	*	*
	b $[C_{31}H_{25}N_3O_3 \cdot 2H_2O]Cu$	*–	*+	*+	*+
	c $[C_{31}H_{25}N_3O_3 \cdot 2H_2O]Zn$	*+	*+–	*+–	*+–
MSB 20	$X=CH_3$, $Y=4-OCH_3$, $R=C_6H_42CH_3$				
	a $[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Ni$	*	*	*	*
	b $[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Cu$	*–	*+	*+	*+
	c $[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Zn$	*+	*+–	*+–	*++
MSB 21	$X=CH_3$, $Y=4-OCH_3$, $R=C_6H_44CH_3$				
	a $[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Ni$	*–	*	*	*
	b $[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Cu$	*–	*–	*–	*–
	c $[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Zn$	*+	*+	*+	*+–

cont....

Table cont...

MSB 22	$X=CH_3$, $Y=4-OCH_3$, $R=C_5H_4N$					
	a	$[C_{29}H_{23}N_5O_3 \cdot 2H_2O]Ni$	*+	*+	*+	*+
	b	$[C_{29}H_{23}N_5O_3 \cdot 2H_2O]Cu$	*+-	*+-	*+-	*+-
	c	$[C_{29}H_{23}N_5O_3 \cdot 2H_2O]Zn$	*++	*++	*++	*++
MSB 23	$X=CH_3$, $Y=4-OCH_3$, $R=C_4H_3S$					
	a	$[C_{27}H_{21}N_3O_3S_2 \cdot 2H_2O]Ni$	*+-	*++	*+-	*+
	b	$[C_{27}H_{21}N_3O_3S_2 \cdot 2H_2O]Cu$	*++	*++	*++	*++
	c	$[C_{27}H_{21}N_3O_3S_2 \cdot 2H_2O]Zn$	*+-	*++	*++	*++

Fig. 4.8

MSB 24	$X=CH_3$, $Y=4-OCH_3$, $R=C_6H_4COOH$					
	a	$[C_{33}H_{23}N_3O_7Ni_2]$	*+-	*+	*+	*+
	b	$[C_{33}H_{23}N_3O_7Cu_2]$	*++	*+-	*+	*-
	c	$[C_{33}H_{23}N_3O_7Zn_2]$	*++	*++	*+-	*+

cont.....

Table cont...

Fig. 4.6

MSB 25	X=H, R=C_6H_5					
	a	$[C_{33}H_{25}N_3O_2 \cdot 2H_2O]Ni$	*	*–	*	*–
	b	$[C_{33}H_{25}N_3O_2 \cdot 2H_2O]Cu$	*–	*+	*–	*+
	c	$[C_{33}H_{25}N_3O_2 \cdot 2H_2O]Zn$	*+	*+	*+–	*++
MSB 26	X=H, R=$C_6H_4{}^2CH_3$					
	a	$[C_{35}H_{29}N_3O_2 \cdot 2H_2O]Ni$	*	*	*	*
	b	$[C_{34}H_{29}N_3O_2 \cdot 2H_2O]Cu$	*	*–	*–	*–
	c	$[C_{35}H_{29}N_3O_2 \cdot 2H_2O]Zn$	*+	*+	*+	*+–
MSB 27	X=H, R=$C_6H_4{}^4CH_3$					
	a	$[C_{35}H_{29}N_3O_2 \cdot 2H_2O]Ni$	*	*	*	*
	b	$[C_{35}H_{29}N_3O_2 \cdot 2H_2O]Cu$	*	*–	*–	*–
	c	$[C_{35}H_{29}N_3O_2 \cdot 2H_2O]Zn$	*+	*+	*+	*+–

cont..

Table cont...

MSB 28	X=H, $R=C_5H_4N$					
	a	$[C_{31}H_{23}N_5O_2 \cdot 2H_2O]Ni$	*+	*+	*+	*+
	b	$[C_{31}H_{23}N_5O_2 \cdot 2H_2O]Cu$	*+	*+-	*+-	*+-
	c	$[C_{31}H_{23}N_5O_2 \cdot 2H_2O]Zn$	*++	*++	*++	*++
MSB 29	X=H, $R=C_4H_3S$					
	A	$[C_{29}H_{21}N_3O_2S_2 \cdot 2H_2O]Ni$	*+	*+-	*+-	*+-
	b	$[C_{29}H_{21}N_3O_2S_2 \cdot 2H_2O]Cu$	*+-	*++	*++	*++
	c	$[C_{29}H_{21}N_3O_2S_2 \cdot 2H_2O]Zn$	*++	*++-	*++-	*++-

Fig. 4.9

MSB 30	X=H, $R=C_6H_4COOH$					
	a	$[C_{35}H_{23}N_3O_6Ni_2]$	*+	*-	*	*-
	b	$[C_{35}H_{23}N_3O_6Cu_2]$	*+	*+	*-	*+
	c	$[C_{35}H_{23}N_3O_6Zn_2]$	*+-	*+-	*+	*+-

Fig. 4.6

MSB 31	X=CH_3, $R=C_6H_5$					
	a	$[C_{34}H_{27}N_3O_2 \cdot 2H_2O]Ni$	*	*	*	*

cont....

Table cont...

b	$[C_{34}H_{27}N_3O_2 \cdot 2H_2O]Cu$	*-	*-	*	*-
c	$[C_{34}H_{27}N_3O_2 \cdot 2H_2O]Zn$	*+	*+	*+-	*+
MSB 32	$X=CH_3$, $R=C_6H_4 2CH_3$				
a	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Ni$	*	*	*	*
b	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Cu$	*	*-	*-	*-
c	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Zn$	*+	*+-	*+	*-
MSB 33	$X=CH_3$, $R=C_6H_4 4CH_3$				
a	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Ni$	*	*	*	*
b	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Cu$	*-	*-	*+	*+
c	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Zn$	*+-	*+-	*+-	*+-
MSB 34	$X=CH_3$, $R=C_5H_4N$				
a	$[C_{32}H_{25}N_5O_2 \cdot 2H_2O]Ni$	*+	*+	*+	*+
b	$[C_{32}H_{25}N_5O_2 \cdot 2H_2O]Cu$	*+	*+-	*+-	*+-
c	$[C_{32}H_{25}N_5O_2 \cdot 2H_2O]Zn$	*++	*++	*++	*++-

cont....

Table cont...

MSB 35 $X=CH_3$, $R=C_4H_3S$

a	$[C_{30}H_{23}N_3O_2S_2 \cdot 2H_2O]Ni$	*++	*+-	*+-	*++
b	$[C_{30}H_{23}N_3O_2S_2 \cdot 2H_2O]Cu$	*+-	*++	*++	*++-
c	$[C_{30}H_{23}N_3O_2S_2 \cdot 2H_2O]Zn$	*++-	*++-	*+++	*+++

Fig. A-9

MSB 36 $X=CH_3$, $R=C_6H_4COOH$

a	$[C_{35}H_{23}N_3O_6Ni_2]$	*+	*+	*+	*+
b	$[C_{35}H_{23}N_3O_6Cu_2]$	*+	*+-	*+-	*+-
c	$[C_{35}H_{23}N_3O_6Zn_2]$	*++	**+	*++	*++-

Fig. A-7

MSB 37 $X=C_6H_5$, $Y=5-Cl$
$R=C_6H_5$

a	$[C_{35}H_{25}N_4OCl \cdot 2H_2O]Ni$	*	*	*	*
b	$[C_{35}H_{25}N_4OCl \cdot 2H_2O]Cu$	*+	*+	*+	*+
c	$[C_{35}H_{25}N_4OCl \cdot 2H_2O]Zn$	*+-	*+-	*++	*++

MSB 38 $X=C_6H_5$, $Y=5-Cl$,
$R=C_6H_42CH_3$

a	$[C_{37}H_{29}N_4OCl \cdot 2H_2O]Ni$	*	*	*	*

cont.

Table cont...

b	$[C_{37}H_{29}N_4OCl.2H_2O]Cu$	*+	*+	*+	*+
c	$[C_{37}H_{29}N_4OCl.2H_2O]Zn$	*+-	*+-	*++	*+-
MSB 39	X=C_6H_5, Y=5-Cl, R=$C_6H_4$4CH_3				
a	$[C_{37}H_{29}N_4OCl.2H_2O]Ni$	*	*	*	*
b	$[C_{37}H_{29}N_4OCl.2H_2O]Cu$	*+	*+	*+	*+
c	$[C_{37}H_{29}N_4OCl.2H_2O]Zn$	*+-	*+-	*++	*+-
MSB 40	X=C_6H_5, Y=5-Cl, R=C_5H_4N				
a	$[C_{33}H_{24}N_6OCl.2H_2O]Ni$	*+	*+	*+	*+
b	$[C_{33}H_{24}N_6OCl.2H_2O]Cu$	*++	*++	*++	*++
c	$[C_{33}H_{24}N_6OCl.2H_2O]Zn$	*++-	*++-	*++-	*+++
MSB 41	X=C_6H_5, Y=5-Cl, R=C_4H_3S				
a	$[C_{31}H_{24}N_4OClS_2.2H_2O]Ni$	*++	*++	*++	*+

092

cont...

Table cont....

b	$[C_{31}H_{24}N_4OClS_2 \cdot 2H_2O]Cu$	*++-	*++-	*+++	*++
c	$[C_{31}H_{24}N_4OClS_2 \cdot 2H_2O]Zn$	*+++-	*+++-	*+++	*+++

Fig. 4.10

MSB 42 $X=C_6H_5$, $Y=5\text{-}Cl$, $R=C_6H_4COOH$

a	$[C_{37}H_{23}N_4O_5ClNi_2]$	*+-	*++	*+	*++
b	$[C_{37}H_{23}N_4O_5ClCu_2]$	*++	*++	*++	*++
c	$[C_{37}H_{23}N_4O_5ClZn_2]$	*++-	*++-	*+++	*+++

PART B TABLE 5.3

Evaluation of pigment fastness properties of Schiff base Complexes derived from aliphatic and aromatic diamines :

	Type of Compounds	light fastness		Rubbing fastness			
				Dry		Wet	
		Cotton	Wool	Cotton	Wool	Cotton	Wool
	Fig. 3.1 X=H, Y=H, R' = $-(CH_2)_2-$						
SB	1.						
	a $[C_{19}H_{15}O_2N_3 \cdot 2H_2O]Ni$	4	5	4	5	5	5
	b $[C_{19}H_{15}O_2N_3 \cdot 2H_2O]Cu$	4	5	4	5	5	5
	c $[C_{19}H_{15}O_2N_3 \cdot 2H_2O]Zn$	4	5	5	5	4	5
SB	2. X=CH_3, Y=H, R' = $-(CH_2)_2-$						
	a $[C_{20}H_{17}O_2N_3 \cdot 2H_2O]Ni$	5	5	4	5	5	5
	b $[C_{20}H_{17}O_2N_3 \cdot 2H_2O]Cu$	4	5	4	5	4	5
	c $[C_{20}H_{17}O_2N_3 \cdot 2H_2O]Zn$	4	5	5	5	3	4
SB	3. X=CH_3, Y=4-OH, R' = $-(CH_2)-$						
	a $[C_{20}H_{17}O_3N_3 \cdot 2H_2O]Ni$	4	5	4	5	5	5
	b $[C_{20}H_{17}O_3N_3 \cdot 2H_2O]Cu$	4	5	4	5	4	5
	c $[C_{20}H_{17}O_3N_3 \cdot 2H_2O]Zn$	3	4	5	5	3	4

cont....

Table cont.

$X=CH_3$, $Y=4-OCH_3$,
$R'=-(CH_2)_2-$

SB 4.							
a	$[C_{21}H_{19}O_3N_3 \cdot 2H_2O]Ni$	4	5	5	5	4	5
b	$[C_{21}H_{19}O_3N_3 \cdot 2H_2O]Cu$	4	5	4	5	4	5
c	$[C_{21}H_{19}O_3N_3 \cdot 2H_2O]Zn$	5	5	3	4	5	5

Fig. 3.2

$X=H$, $R'=-(CH_2)_2-$

SB 5.							
a	$[C_{23}H_{17}O_2N_3 \cdot 2H_2O]Ni$	5	5	4	5	4	5
b	$[C_{23}H_{17}O_2N_3 \cdot 2H_2O]Cu$	5	6	4	5	4	5
c	$[C_{23}H_{17}O_2N_3 \cdot 2H_2O]Zn$	4	5	3	4	5	5

$X=CH_3$, $R'=-(CH_2)_2-$

SB 6.							
a	$[C_{24}H_{19}O_2N_2 \cdot 2H_2O]Ni$	5	5	4	5	5	5
b	$[C_{24}H_{19}O_2N_2 \cdot 2H_2O]Cu$	5	5	4	5	5	6
c	$[C_{24}H_{19}O_2N_2 \cdot 2H_2O]Zn$	4	5	5	4	4	4

Fig. 3.3

SB 7. $X=C_6H_5$, $Y=5-Cl$,
$R=-(CH_2)_2-$

a	$[C_{25}H_{20}ON_4Cl \cdot 2H_2O]Ni$	5	5	5	5	4	5
b	$[C_{25}H_{20}ON_4Cl \cdot 2H_2O]Cu$	5	5	3	4	4	5
c	$[C_{25}H_{20}ON_4Cl \cdot 2H_2O]Zn$	4	5	4	5	3	4

cont...

Table cont.

Fig. 3.1

SB 8.	$X=CH_3$, $Y=H$, $R'=-(CH_2)_3-$							
a	$[C_{20}H_{17}O_2N_3 \cdot 2H_2O]Ni$	5	5	5	5	4	5
b	$[C_{20}H_{17}O_2N_3 \cdot 2H_2O]Cu$	5	5	4	5	4	5
c	$[C_{20}H_{17}O_2N_3 \cdot 2H_2O]Zn$	4	5	4	5	3	4
SB 9.	$X=CH_3$, $Y=H$, $R'=-(CH_2)_3-$							
a	$[C_{21}H_{19}O_2N_3 \cdot 2H_2O]Ni$	4	5	4	5	3	4
b	$[C_{21}H_{19}O_2N_3 \cdot 2H_2O]Cu$	4	5	4	5	4	5
c	$[C_{21}H_{19}O_2N_3 \cdot 2H_2O]Zn$	3	4	3	4	4	5
SB 10.	$X=CH_3$, $Y=4-OH$, $R'=-(CH_2)_3-$							
a	$[C_{21}H_{19}O_3N_3 \cdot 2H_2O]Ni$	4	5	4	5	4	5
b	$[C_{21}H_{19}O_3N_3 \cdot 2H_2O]Cu$	4	5	3	4	5	5
c	$[C_{21}H_{19}O_3N_3 \cdot 2H_2O]Zn$	3	4	3	4	4	5
SB 11.	$X=CH_3$, $Y=4-OC_6H_3$, $R'=-(CH_2)_3-$							
a	$[C_{21}H_{19}O_3N_3 \cdot 2H_2O]Ni$	4	5	4	5	4	5
b	$[C_{21}H_{19}O_3N_3 \cdot 2H_2O]Cu$	4	5	3	4	5	5
c	$[C_{21}H_{19}O_3N_3 \cdot 2H_2O]Zn$	3	4	4	5	3	4

cont....

Table cont..

Fig. 3·2

SB	12.	$X=H$, $R'=-(CH_2)_3-$						
	a	$[C_{24}H_{19}O_2N_3.2H_2O]Ni$	4	5	4	5	4	5
	b	$[C_{24}H_{19}O_2N_3.2H_2O]Cu$	4	5	5	5	4	5
	c	$[C_{24}H_{19}O_2N_3.2H_2O]Zn$	3	5	3	4	4	4
SB	13.	$X=CH_3$, $R'=-(CH_2)_3-$						
	a	$[C_{25}H_{21}O_2N_3.2H_2O]Ni$	4	5	3	4	3	4
	b	$[C_{25}H_{21}O_2N_3.2H_2O]Cu$	4	5	4	5	4	5
	c	$[C_{25}H_{21}O_2N_3.2H_2O]Zn$	3	4	4	5	3	4

Fig. 3·3

SB	14.	$X=C_6H_5$, $Y=5-Cl$, $R'=-(CH_2)_3-$						
	a	$[C_{26}H_{22}ON_4Cl.2H_2O]Ni$	4	5	3	4	3	4
	b	$[C_{26}H_{22}ON_4Cl.2H_2O]Cu$	3	4	3	4	2	3
	c	$[C_{26}H_{22}ON_4Cl.2H_2O]Zn$	3	4	3	4	3	4

Fig. 3·4

SB	15.	$X=H$, $Y=H$, $R'=C_6H_4$						
	a	$[C_{23}H_{17}O_2N_3.2H_2ONi]_2$	5	5	5	5	5	5
	b	$[C_{23}H_{17}O_2N_3.2H_2OCu]_2$	5	5	4	5	4	5
	c	$[C_{23}H_{17}O_2N_3.2H_2OZn]_2$	4	5	5	5	4	5

cont....

Table cont.....

SB 16.	$X=CH_3$, $Y=H$, $R'=-C_6H_5$							
a	$[C_{24}H_{19}O_2N_3 \cdot 2H_2ONi_2]$	5	5	4	5	5	5	5
b	$[C_{24}H_{19}O_2N_3 \cdot 2H_2OCu_2]$	5	5	4	5	5	4	5
c	$[C_{24}H_{19}O_2N_3 \cdot 2H_2OZn_2]$	5	6	5	5	4	5	
SB 17.	$X=CH_3$, $Y=4-OH$, $R'=-C_6H_5-$							
a	$[C_{28}H_{21}O_3N_3 \cdot 2H_2ONi_2]$	5	5	5	5	4	5	
b	$[C_{24}H_{19}O_3N_3 \cdot 2H_2OCu_2]$	5	5	5	5	5	5	
c	$[C_{24}H_{19}O_3N_3 \cdot 2H_2OZn_2]$	5	5	4	5	5	5	
SB 18.	$X=CH_3$, $Y=4-OCH_3$, $R'=C_6H_5$							
a	$[C_{25}H_{21}O_3N_3 \cdot 2H_2ONi_2]$	5	5	5	5	4	5	
b	$[C_{25}H_{21}O_3N_3 \cdot 2H_2OCu_2]$	6	5	5	5	5	4	5
c	$[C_{25}H_{21}O_3N_3 \cdot 2H_2OZn_2]$	5	5	4	5	5	5	
SB 19.	$X=H$, $R=-C_6H_5-$ Fig. 3.5							
a	$[C_{27}H_{19}O_2N_3 \cdot 2H_2ONi_2]$	6	5	5	5	4	5	
b	$[C_{27}H_{19}O_2N_3 \cdot 2H_2OCu_2]$	5	6	4	5	5	5	
c	$[C_{27}H_{19}O_2N_3 \cdot 2H_2OZn_2]$	4	5	4	5	5	5	

cont...

Table cont.

$X=CH_3$, $R'=-C_6H_4-$

SB 20.							
a	$[C_{28}H_{21}O_2N_3 \cdot 2H_2ONi]_2$	5	5	5	5	4	5
b	$[C_{28}H_{21}O_2N_3 \cdot 2H_2OCu]_2$	5	5	5	5	5	5
c	$[C_{28}H_{21}O_2N_3 \cdot 2H_2OZn]_2$	4	5	4	5	5	5

Fig. 3·6

$X=C_6H_5$, $Y=5-Cl$, $R'=-C_6H_4-$

SB 21.							
a	$[C_{29}H_{22}ON_4Cl \cdot 2H_2ONi]_2$	5	5	4	5	5	5
b	$[C_{29}H_{22}ON_4Cl \cdot 2H_2OCu]_2$	5	5	4	5	4	5
c	$[C_{29}H_{22}ON_4Cl \cdot 2H_2OZn]_2$	4	5	5	5	4	5

Fig. 3·4

$X=H$, $Y=H$, $R'=-C_6H_4-C_6H_4-$

SB 22.							
a	$[C_{29}H_{21}O_2N_3 \cdot 2H_2ONi]_2$	5	5	5	5	5	5
b	$[C_{29}H_{21}O_2N_3 \cdot 2H_2OCu]_2$	5	5	5	5	4	5
c	$[C_{29}H_{21}O_2N_3 \cdot 2H_2OZn]_2$	5	6	4	5	5	5

$X=CH_3$, $Y=H$, $R'=-C_6H_4-C_6H_4-$

SB 23.							
a	$C_{30}H_{21}O_2N_3 \cdot 2H_2ONi]_2$	6	6	5	5	4	5
b	$C_{30}H_{21}O_2N_3 \cdot 2H_2OCu]_2$	6	5	5	5	5	5
c	$C_{30}H_{21}O_2N_3 \cdot 2H_2OZn]_2$	5	6	5	5	4	5

cont...

Table cont...

$X=CH_3$, Y=H, -OH,

$R' = -C_6H_4-C_6H_5-$

SB 24.							
a	$[C_{30}H_{23}O_3N_3 \cdot 2H_2ONi]_2$	6	5	5	5	5	5
b	$[C_{30}H_{23}O_3N_3 \cdot 2H_2OCu]_2$	5	5	4	5	4	5
c	$[C_{30}H_{23}O_3N_3 \cdot 2H_2OZn]_2$	6	6	5	4	5	5

$X=CH_3$, Y=4-OCH_3

$R' = -C_6H_4-C_6H_4-$

SB 25.							
a	$[C_{31}H_{25}O_3N_3 \cdot 2H_2ONi]_2$	6	6	5	5	4	5
b	$[C_{31}H_{25}O_3N_3 \cdot 2H_2OCu]_2$	6	5	5	5	5	5
c	$[C_{31}H_{25}O_3N_3 \cdot 2H_2OZn]_2$	5	5	5	5	4	5

Fig. 3.5

X=H,

$R' = -C_6H_4-C_6H_4-$

SB 26.							
a	$[C_{33}H_{23}O_2N_3 \cdot 2H_2ONi]_2$	6	6	5	5	5	5
b	$[C_{33}H_{23}O_2N_3 \cdot 2H_2OCu]_2$	5	5	4	5	4	5
c	$[C_{33}H_{23}O_2N_3 \cdot 2H_2OZn]_2$	5	5	5	5	5	4

cont....

Table cont..

$X=CH_3$,

$R' = -C_6H_4-C_6H_4-$

SB 27.							
	a $\left[C_{34}H_{25}O_2N_3 \cdot 2H_2ONi\right]_2$	6	5	5	5	4	5
	b $\left[C_{34}H_{25}O_2N_3 \cdot 2H_2OCu\right]_2$	6	6	5	5	4	5
	c $\left[C_{34}H_{25}O_2N_3 \cdot 2H_2OZn\right]_2$	5	5	5	4	5	5

Fig. 3.6

$X=C_6H_5$,

$Y=5-Cl$, $R'=-C_6H_4-C_6H_4-$

SB 28.							
	a $\left[C_{35}H_{26}ON_4Cl \cdot 2H_2ONi\right]_2$	6	5	5	5	5	5
	b $\left[C_{35}H_{26}ON_4Cl \cdot 2H_2OCu\right]_2$	5	5	4	5	5	5
	c $\left[C_{35}H_{26}ON_4Cl \cdot 2H_2OZn\right]_2$	5	5	5	5	4	5

Table 5.4

Evaluation of fastness properties based on 7-formyl 8-Hydroxyquinoline Mixed Schiff base Complexes using Aromatic amines

	Pigment Type of Compounds MSB = mixed Schiff base	light fastness		Rubbing fastness			
				Dry		Wet	
		Cotton	Wool	Cotton	Wool	Cotton	Wool
MSB	1. Fig. 4.5 X=H, Y=H, R=C_6H_5						
	a $[C_{29}H_{21}N_3O_2.2H_2O]Ni$	5	6	4	5	4	5
	b $[C_{29}H_{21}N_3O_2.2H_2O]Cu$	4	5	4	5	5	5
	c $[C_{29}H_{21}N_3O_2.2H_2O]Zn$	4	5	4	5	5	4
MSB	2. X=H, Y=H, R=C_6H_4 2-CH_3						
	a $[C_{31}H_{25}N_3O_2.2H_2O]Ni$	5	6	5	4	4	5
	b $[C_{31}H_{25}N_3O_2.2H_2O]Cu$	5	6	4	5	4	5
	c $[C_{31}H_{25}N_3O_2.2H_2O]Zn$	4	5	5	4	4	5
MSB	3. X=H, Y=H, R=$C_6H_4CH_3$						
	a $[C_{31}H_{25}N_3O_2.2H_2O]Ni$	5	6	5	4	4	5
	b $[C_{31}H_{25}N_3O_2.2H_2O]Cu$	4	5	4	5	5	4
	c $[C_{31}H_{25}N_3O_2.2H_2O]Zn$	5	6	4	5	5	4

cont....

Table cont..

MSB 4.							
a	$[C_{27}H_{19}N_5O_2 \cdot 2H_2O]Ni$	4	5	4	5	4	5
b	$[C_{27}H_{19}N_5O_2 \cdot 2H_2O]Cu$	4	5	4	5	3	4
c	$[C_{27}H_{19}N_5O_2 \cdot 2H_2O]Zn$	3	4	4	5	4	5
MSB 5.	X=H, Y=H, R=C_4H_3S						
a	$[C_{25}H_{17}N_3O_2S_2 \cdot 2H_2O]Ni$	4	5	4	5	5	5
b	$[C_{25}H_{17}N_3O_2S_2 \cdot 2H_2O]Cu$	3	4	4	5	4	5
c	$[C_{25}H_{17}N_3O_2S_2 \cdot 2H_2O]Zn$	4	5	5	5	5	5

Fig. 4.8

MSB 6.	X=H, Y=H, R=C_6H_4COOH						
a	$[C_{31}H_{19}N_3O_6Ni_2]$	6	5	5	5	4	5
b	$[C_{31}H_{19}N_3O_6Cu_2]$	5	5	4	5	4	5
c	$[C_{31}H_{19}N_3O_6Zn_2]$	5	5	4	5	5	4

Fig. 4.5

MSB 7.	X=CH_3, Y=H, R=C_6H_5						
a	$[C_{30}H_{23}N_3O_2 \cdot 2H_2O]Ni$	4	5	4	5	5	5
b	$[C_{30}H_{23}N_3O_2 \cdot 2H_2O]Cu$	4	5	4	5	4	5
c	$[C_{30}H_{23}N_3O_2 \cdot 2H_2O]Zn$	5	5	5	5	4	5

cont...

Table cont...

MSB 8. $X=CH_3$, $Y=H$, $R=C_6H_4-CH_3$

a	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Ni$	5	5		4	5	5	5
b	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Cu$	6	5		5	5	4	5
c	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Zn$	5	6		4	5	4	5

MSB 9. $X=CH_3$, $Y=H$, $R=C_6H_4 4CH_3$

a	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Ni$	5	5		4	5	5	5
b	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Cu$	5	5		4	5	4	5
c	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Zn$	4	5		5	5	4	5

MSB 10. $X=CH_3$, $Y=H$, $R=C_5H_4N$

a	$[C_{28}H_{21}N_5O_2 \cdot 2H_2O]Ni$	4	5		5	5	4	5
b	$[C_{28}H_{21}N_5O_2 \cdot 2H_2O]Cu$	4	5		4	5	4	5
c	$[C_{28}H_{21}N_5O_2 \cdot 2H_2O]Zn$	4	5		4	5	5	5

MSB 11. $X=CH_3$, $Y=H$, $R=C_4H_3S$

a	$[C_{26}H_{19}N_3O_2S_2 \cdot 2H_2O]Ni$	5	5		5	5	4	5
b	$[C_{26}H_{19}N_3O_2S_2 \cdot 2H_2O]Cu$	4	5		5	5	4	5
c	$[C_{26}H_{19}N_3O_2S_2 \cdot 2H_2O]Zn$	4	5		4	5	5	5

cont...

Table cont.

Fig.4·8

MSB 12.

$X=CH_3$, $Y=H$,

$R=C_6H_4COOH$

a	$[C_{32}H_{21}N_3O_6Ni_2]$	6	6	5	5	5	5
b	$[C_{32}H_{21}N_3O_6Cu_2]$	5	5	4	5	5	5
c	$[C_{32}H_{21}N_3O_6Zn_2]$	5	5	5	5	4	5

Fig.4·5

MSB 13.

$X=CH_3$, $Y=4-OH$,

$R=C_6H_5$

a	$[C_{30}H_{23}N_3O_3\cdot 2H_2O]Ni$	5	5	5	5	5	5
b	$[C_{30}H_{23}N_3O_3\cdot 2H_2O]Cu$	4	5	5	5	4	5
c	$[C_{30}H_{23}N_3O_3\cdot 2H_2O]Zn$	4	5	5	4	5	5

MSB 14.

$X=CH_3$, $Y=4-OH$,

$R=C_6H_4 2-CH_3$

a	$[C_{32}H_{27}N_3O_3\cdot 2H_2O]Ni$	5	5	4	5	5	5
b	$[C_{32}H_{27}N_3O_3\cdot 2H_2O]Cu$	5	4	4	5	4	5
c	$[C_{32}H_{27}N_3O_3\cdot 2H_2O]Zn$	4	5	5	5	5	4

MSB 15.

$X=CH_3$, $Y=4-OH$,

$R=C_6H_4 4-CH_3$

a	$[C_{32}H_{27}N_3O_3\cdot 2H_2O]Ni$	5	5	4	5	5	5
b	$[C_{32}H_{27}N_3O_3\cdot 2H_2O]Cu$	4	5	4	5	4	5
c	$[C_{32}H_{27}N_3O_3\cdot 2H_2O]Zn$	4	5	5	4	5	5

cont...

MSB 16. $X=CH_3$, $Y=4-OH$, $R=C_5H_4N$

a	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Ni$	5	5	5	5	5	5
b	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Cu$	4	5	4	5	5	5
c	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Zn$	4	5	5	5	5	5

MSB 17. $X=CH_3$, $Y=4-OH$, $R=C_4H_3S$

a	$[C_{26}H_{19}N_3O_3S_2 \cdot 2H_2O]Ni$	4	5	5	5	5	5
b	$[C_{26}H_{19}N_3O_3S_2 \cdot 2H_2O]Cu$	4	5	4	5	4	5
c	$[C_{26}H_{19}N_3O_3S_2 \cdot 2H_2O]Zn$	4	5	5	5	4	5

MSB 18. Fig. A·8

$X=CH_3$, $Y=4-OH$, $R=C_6H_4COOH$

a	$[C_{32}H_{21}N_3O_7Ni_2]$	6	5	5	5	4	5
b	$[C_{32}H_{21}N_3O_7Cu_2]$	5	6	5	5	5	4
c	$[C_{32}H_{21}N_3O_7Zn_2]$	5	5	4	5	5	5

MSB 19. Fig. A·5

$X=CH_3$, $Y=4-OCH_3$, $R=C_6H_5$

a	$[C_{31}H_{25}N_3O_3 \cdot 2H_2O]Ni$	5	5	5	5	4	5
b	$[C_{31}H_{25}N_3O_3 \cdot 2H_2O]Cu$	5	5	4	5	5	4
c	$[C_{31}H_{25}N_3O_3 \cdot 2H_2O]Zn$	4	5	4	5	4	5

cont...

Table cont..

MSB	20. $X=CH_3$, $Y=4-OCH_3$, $R=C_6H_42CH_3$							
	a	$[C_{33}H_{29}N_3O_3.2H_2O]Ni$	5	5	4	5	5	5
	b	$[C_{33}H_{29}N_3O_3.2H_2O]Cu$	5	5	4	5	5	4
	c	$[C_{33}H_{29}N_3O_3.2H_2O]Zn$	4	5	5	5	4	5
MSB	21. $X=CH_3$, $Y=4-OCH_3$ $R=C_6H_44CH_3$							
	a	$[C_{33}H_{29}N_3O_3.2H_2O]Ni$	5	5	5	5	5	5
	b	$[C_{33}H_{29}N_3O_3.2H_2O]Cu$	5	5	4	5	5	5
	c	$[C_{33}H_{29}N_3O_3.2H_2O]Zn$	4	5	5	5	4	5
MSB	22. $X=CH_3$, $Y=4-OCH_3$ $R=C_5H_4N$							
	a	$[C_{29}H_{23}N_5O_3.2H_2O]Ni$	3	4	4	5	5	5
	b	$[C_{29}H_{23}N_5O_3.2H_2O]Cu$	4	5	3	4	4	5
	c	$[C_{29}H_{23}N_5O_3.2H_2O]Zn$	4	5	4	5	4	5
MSB	23. $X=CH_3$, $Y=4-OCH_3$, $R=C_4H_3S$							
	a	$[C_{27}H_{21}N_3O_3S_2.2H_2O]Ni$	4	5	5	5	4	5
	b	$[C_{27}H_{21}N_3O_3S_2.2H_2O]Cu$	5	5	3	4	3	4
	c	$[C_{27}H_{21}N_3O_3S_2.2H_2O]Zn$	4	5	4	5	4	5

cont...

Table cont.

MSB 24. Fig. A.8

X=CH_3, Y=4-OCH_3, R=C_6H_4COOH

a	$[C_{33}H_{23}N_3O_7Ni_2]$	6	5	4	5	5	5
b	$[C_{33}H_{23}N_3O_7Cu_2]$	5	5	5	5	4	5
c	$[C_{33}H_{23}N_3O_7Zn_2]$	5	5	4	5	4	5

MSB 25. Fig. A.6

X=H, R=C_6H_5

a	$[C_{33}H_{25}N_3O_2.2H_2O]Ni$	5	5	5	5	5	5
b	$[C_{33}H_{25}N_3O_2.2H_2O]Cu$	4	5	4	5	5	5
c	$[C_{33}H_{25}N_3O_2.2H_2O]Zn$	5	5	5	6	4	5

MSB 26.

X=H, R=C_6H_4 2-CH_3

a	$[C_{35}H_{29}N_3O_2.2H_2O]Ni$	5	5	4	5	5	5
b	$[C_{35}H_{29}N_3O_2.2H_2O]Cu$	5	5	5	6	4	5
c	$[C_{35}H_{29}N_3O_2.2H_2O]Zn$	4	5	3	5	4	5

MSB 27.

X=H, R=C_6H_4 4-CH_3

a	$[C_{35}H_{29}N_3O_2.2H_2O]Ni$	5	5	4	5	5	5
b	$[C_{35}H_{29}N_3O_2.2H_2O]Cu$	5	4	3	4	4	5
c	$[C_{35}H_{29}N_3O_2.2H_2O]Zn$	4	5	4	5	4	5

MSB 28.

X=H, R=C_5H_4N

a	$[C_{31}H_{23}N_5O_2.2H_2O]Ni$	5	5	4	5	4	5

cont....

Table cont.

b	$[C_{31}H_{23}N_5O_2 \cdot 2H_2O]Cu$	4	5	3	4	4	5
c	$[C_{31}H_{23}N_5O_2 \cdot 2H_2O]Zn$	4	5	4	5	5	5

MSB 29.

X=H, R=C_4H_3S

a	$[C_{29}H_{21}N_3O_2S_2 \cdot 2H_2O]Ni$	4	5	4	5	5	5
b	$[C_{29}H_{21}N_3O_2S_2 \cdot 2H_2O]Cu$	4	4	4	5	4	5
c	$[C_{29}H_{21}N_3O_2S_2 \cdot 2H_2O]Zn$	3	5	5	5	5	5

MSB 30. Fig. 4·9

X=H, R=C_6H_4COOH

a	$[C_{35}H_{23}N_3O_6Ni_2]$	6	5	4	5	5	5
b	$[C_{35}H_{23}N_3O_6Cu_2]$	5	6	4	5	5	5
c	$[C_{35}H_{23}N_3O_6Zn_2]$	5	5	5	5	4	5

MSB 31. Fig. 4·6

X=CH_3, R=C_6H_5

a	$[C_{34}H_{27}N_3O_2 \cdot 2H_2O]Ni$	5	5	5	5	4	5
b	$[C_{34}H_{27}N_3O_2 \cdot 2H_2O]Cu$	5	5	3	4	4	5
c	$[C_{34}H_{27}N_3O_2 \cdot 2H_2O]Zn$	4	5	4	5	3	4

MSB 32.

X=CH_3, R=C_6H_4 2-CH_3

a	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Ni$	5	5	4	5	4	5
b	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Cu$	5	5	3	4	4	5
c	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Zn$	4	5	4	5	5	4

cont...

Table cont..

MSB 33.	$X=CH_3$, $R=C_6H_4$ 4-CH_3							
a	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Ni$	4	5	4	5	5	5
b	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Cu$	5	5	5	4	4	4
c	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Zn$	4	5	5	5	5	5
MSB 34.	$X=CH_3$, $R=C_5H_4N$							
a	$[C_{32}H_{25}N_5O_2 \cdot 2H_2O]Ni$	4	5	5	5	4	5
b	$[C_{32}H_{25}N_5O_2 \cdot 2H_2O]Cu$	4	5	4	5	5	5
c	$[C_{32}H_{25}N_5O_2 \cdot 2H_2O]Zn$	3	4	4	4	4	5
MSB 35.	$X=CH_3$, $R=C_4H_3S$							
a	$[C_{30}H_{23}N_3O_2S_2 \cdot 2H_2O]Ni$	4	5	5	5	4	4
b	$[C_{30}H_{23}N_3O_2S_2 \cdot 2H_2O]Cu$	4	5	4	5	5	5
c	$[C_{30}H_{23}N_3O_2S_2 \cdot 2H_2O]Zn$	4	4	4	5	4	5
	Fig. A·9							
MSB 36.	$X=CH_3$, $R=C_6H_4COOH$							
a	$[C_{35}H_{23}N_3O_6Ni_2]$	6	5	4	5	5	5
b	$[C_{35}H_{23}N_3O_6Cu_2]$	5	6	5	5	5	5
c	$[C_{35}H_{23}N_3O_6Zn_2]$	5	5	5	5	4	5
	Fig. A·7							
MSB 37.	$X=C_6H_5$, Y=5Cl, $R=C_6H_5$							
a	$[C_{35}H_{25}H_4OCl_2H_2O]Ni$	5	5	4	5	5	4

cont..

Table cont.

b	$[C_{35}H_{25}N_4OCl.2H_2O]Cu$	5	5	5	5	5	5
c	$[C_{35}H_{25}N_4OCl.2H_2O]Zn$	4	5	4	5	4	5

MSB 38.

$X=C_6H_5$, Y=5-Cl,
$R=C_6H_4 2CH_3$

a	$[C_{37}H_{29}N_4OCl.2H_2O]Ni$	5	5	5	5	5	5
b	$[C_{37}H_{29}N_4OCl.2H_2O]Cu$	5	5	4	4	5	6
c	$[C_{37}H_{29}N_4OCl.2H_2O]Zn$	5	5	5	5	4	5

MSB 39.

$X=C_6H_5$, Y=5-Cl,
$R=C_6H_4 4CH_3$

a	$[C_{37}H_{29}N_4OCl.2H_2O]Ni$	5	5	4	4	5	5=
b	$[C_{37}H_{29}N_4OCl.2H_2O]Cu$	5	6	4	5	5	5
c	$[C_{37}H_{29}N_4OCl.2H_2O]Zn$	4	5	5	6	4	5

MSB 40.

$X=C_6H_5$, Y=5-Cl
$R=C_5H_4N$

a	$[C_{33}H_{24}N_6OCl.2H_2O]Ni$	4	5	4	5	4	5
b	$[C_{33}H_{24}N_6OCl.2H_2O]Cu$	3	4	4	5	3	4
c	$[C_{33}H_{24}N_6OCl.2H_2O]Zn$	4	5	5	5	4	5

cont...

Table cont.

MSB 41.

$X=C_6H_5$, Y=5-Cl,

$R=C_4H_3S$

a	$[C_{31}H_{21}N_4OClS_2 \cdot 2H_2O]Ni$	4	5	5	5	4	5
b	$[C_{31}H_{21}N_4OClS_2 \cdot 2H_2O]Cu$	4	5	4	5	4	5
c	$[C_{31}H_{21}N_4OClS_2 \cdot 2H_2O]Zn$	5	6	4	5	5	6

MSB 42. Fig. 4.10

$X=C_6H_5$, Y=5-Cl,

$R=C_6H_4COOH$

a	$[C_{37}H_{23}N_4O_5Cl \cdot Ni]_2$	6	5	4	5	5	5
b	$[C_{37}H_{23}N_4O_5Cl \cdot Cu]_2$	5	6	4	5	4	5
c	$[C_{37}H_{23}N_4O_5Cl \cdot Zn]_2$	5	5	5	4	4	5

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