

then raised to 3.5 with ammonia and excess of purpurogallin in ethanol (1%) was added to this solution. The solution was boiled for 10-15 minutes to remove all ethanol when molybdenum was completely precipitated and then kept aside for 1-2 hours. The precipitate was filtered through a Whatman (No. 42) filter-paper and washed with a solution of pH 3.5 containing reagent (0.1%), ammonium fluoride and ammonium nitrate. The precipitate was finally washed with ammonium nitrate solution of pH 3.5 and ignited to oxide at 500-550°C. as molybdenum trioxide volatilizes at higher temperatures. The results in Table I show that molybdenum can be separated from an approximately equal amount of zirconium and twice its weight of titanium.

The authors are thankful to Prof. T. R. Seshadri, F.R.S., for his help and encouragement.
Department of Chemistry,
University of Delhi,
Delhi, November 5, 1965.

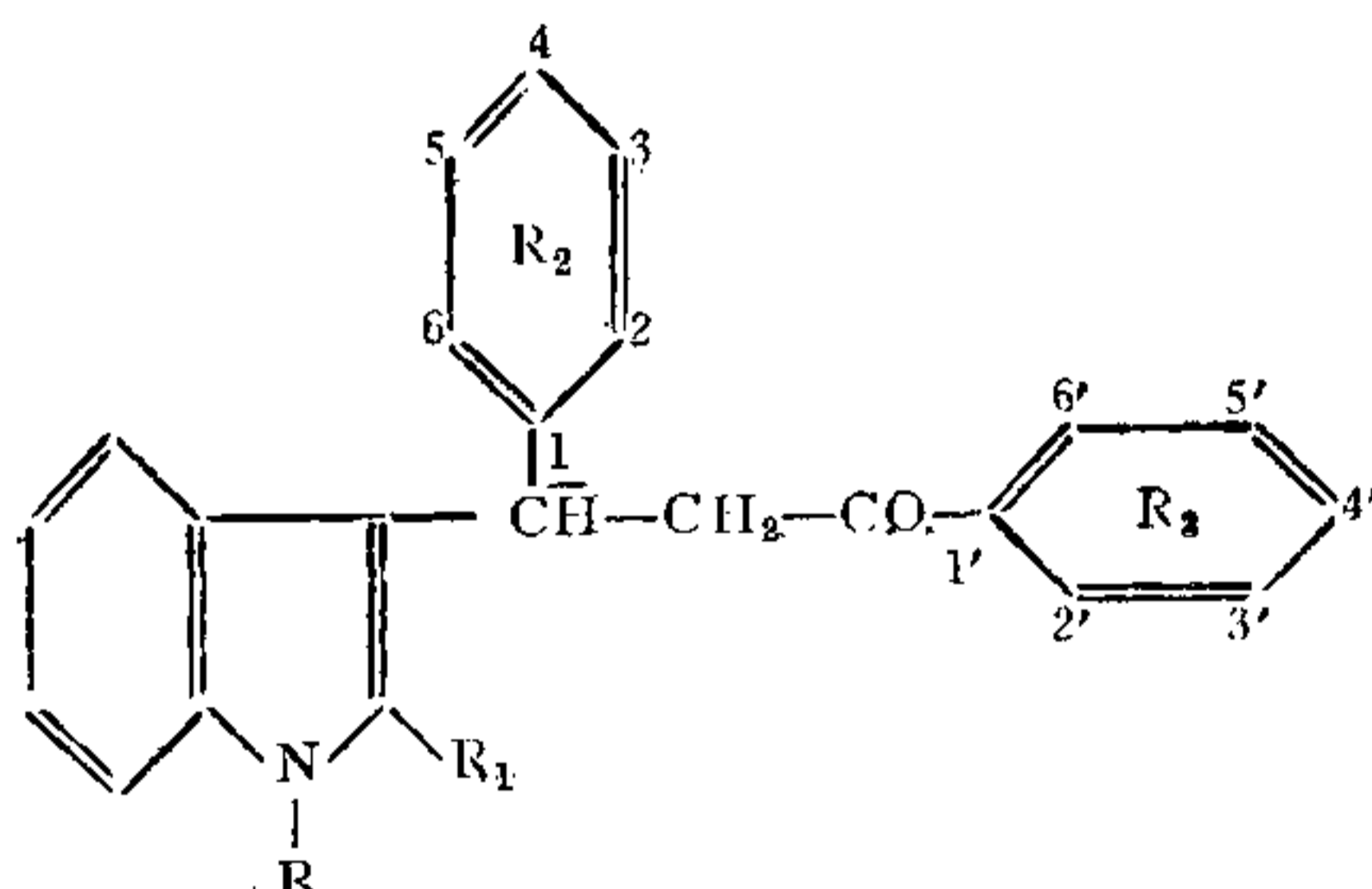
YAG DUTT.
R. P. SINGH.

1. Dutt, Y. and Singh, R. P., *Ind. J. Appl. Chem.*, 1963, 26, 77.
2. Evans, T. W. and Dehn, W. M., *Amer. Chem. Soc.*, 1930, 52, 3647.

HETEROCYCLIC COMPOUNDS (X): REACTION OF INDOLES WITH CHALCONES

IN our previous communications we have reported the condensation of indole derivatives with dienophiles, such as β -nitrostyrenes¹ and methyl vinyl ketone² to form adducts. In connection with another project, we investigated the reaction of indoles with chalcones. The present communication describes for the first time reactions of indole, 2-methylindole, 2-phenylindole and N-methylindole with different chalcones to yield compounds (Table I) of the general structure given below.

TABLE I



No.	R	R ₁	R ₂	R ₃	Mol. Formula	m.p. (°)	Carbon %		Hydrogen %	
							Found	Required	Found	Required
I*	H	H	..	..	C ₂₃ H ₁₉ NO	140	84.8	84.9	5.4	5.8
II†	H	H	4-MeO-	..	C ₂₄ H ₂₁ NO ₂	162	81.1	81.1	5.8	5.9
III	H	H	2-CH ₃ -	4'-CH ₃ -	C ₂₅ H ₂₃ NO	164	84.7	84.9	6.7	6.5
IV	H	H	4-MeO-	4'-MeO	C ₂₅ H ₂₃ NO ₃	155	77.9	77.9	6.3	5.9
V	H	CH ₃ -	2-CH ₃ -	4'-CH ₃ -	C ₂₆ H ₂₅ NO	137	85.1	85.0	6.7	6.8
VI	H	CH ₃	4-MeO	4'-CH ₃	C ₂₆ H ₂₅ NO ₂	163	81.8	81.4	6.9	6.5
VII	H	CH ₃	4-MeO-	4'-MeO	C ₂₆ H ₂₅ NO ₃	172	78.2	78.2	6.6	6.2
VIII	CH ₃	H	..	..	C ₂₄ H ₂₁ NO	175	84.0	84.0	6.5	6.2
IX‡	CH ₃	H	4-MeO	..	C ₂₅ H ₂₃ NO ₂	130-131	81.2	81.2	5.9	6.2
X	CH ₃	H	2-CH ₃	4'-CH ₃	C ₂₆ H ₂₅ NO	171	84.9	85.0	6.8	6.8
XI	CH ₃	H	4-MeO	4'-CH ₃	C ₂₆ H ₂₅ NO ₂	158	81.2	81.4	6.5	6.5
XII	CH ₃	H	4-MeO	4'-MeO	C ₂₆ H ₂₅ NO ₃	168	75.5	78.2	6.5	6.2
XIII	H	C ₆ H ₅	2-CH ₃	4'-CH ₃	C ₃₁ H ₂₇ NO	213	86.3	86.7	6.2	6.29
XIV	H	C ₆ H ₅	4-MeO	4'-CH ₃	C ₃₁ H ₂₇ NO ₂	186	83.3	83.59	6.5	6.07

* 2, 4-DNP (crystallised from acetic acid), m.p. 226-227° (N, Found 14.2%; required 13.9%).
 † 2, 4-DNP (do.), m.p. 218° (N, Found 12.9%; required 12.7%).
 ‡ 2, 4-DNP (do.) m.p. 193° (N, Found 13.0%; required 12.7%).

The reaction was usually carried out by heating equimolecular quantities of the components together in the presence of a mixture of acetic acid and acetic anhydride. The yields varied from 10 to 65%. In some cases the adducts were characterised by the preparation of 2,4-dinitrophenylhydrazones.

Organic Chemistry Dept., J. R. MERCHANT.

Institute of Science, S. S. SALGAR.

Bombay-1,

K. M. CHHATRIWALLA.

November 4, 1965.

1. Salgar, S. S. and Merchant, J. R., *J. prakt. Chem.*, 1961, **14**, 108.

2. Merchant, J. R. and Salgar, S. S., *J. Ind. Chem. Soc.*, 1963, **40**, 83.

**AMINO-ACIDS OF LOBARIA
SUBISIDIOSA, UMBILICARIA
PUSTULATA, PARMELIA NEPALENSIS
AND RAMALINA SINENSIS**

IN continuation of our earlier work on the amino-acid composition of Indian lichens¹⁻³ we have examined *Lobaria subsidiosa*, *Umbilicaria pustulata* and *Parmelia nepalensis* from the Himalayan ranges and *Ramalina sinensis* from the Nilgiris for their amino-acids (both free and combined) and our results are given in brief in Table I.

Lobaria subsidiosa (Asah.) growing on pine trees in the Ganghariya area (alt. 10,000 ft.) has been found to contain about 7.8% of protein (Kjeldahl) as compared to a high value of about 22% in *Lobaria isidiosa*, and in its amino-acid composition it resembles *L. isidiosa* in having almost a similar pattern so far as the combined amino-acids are concerned, but lacks glutamic acid, serine, tryptophan, tyrosine and valine in the free state. *L. isidiosa* does not contain any free glycine and methionine which are present in *L. subsidiosa*. It may be mentioned here that *Lobaria* lichens have been recorded⁴ as useful for lung troubles and in the cure of eczema.

Umbilicaria pustulata (L.) Hoffm. growing on rocks in the Basudhara area (alt. 11,500 ft.) has been found to contain about 6.8% of protein and no histidine, either free or combined. *Parmelia nepalensis* (Tayl.) from the Joshimath area (alt. 7,500 ft.) contains 7.6% of protein with a characteristic predominance of free amino-acids when compared with *Parmelia tinctorum* reported earlier.¹⁻³ *Ramalina sinensis* growing on trees in the Nilgiris in South India contains 7.5% of protein with a characteristic absence of free amino-acids except alanine and tyrosine. As a member of the *Usneaceae* family, it resembles other *Usnea* lichens in the combined amino-acid pattern reported earlier.¹

TABLE I

Amino-acid composition of *Lobaria subsidiosa*, *Umbilicaria pustulata*, *Parmelia nepalensis* and *Ramalina sinensis*

Sl. No.	Amino acids	<i>Lobaria subsidiosa</i>		<i>Umbilicaria pustulata</i>		<i>Parmelia nepalensis</i>		<i>Ramalina sinensis</i>		
		Free*	Combined †	Free*	Combined †	Free*	Combined †	Free*	Combined †	
1	Alanine	..	+	3+	2+	2+	2+	3+	+	2+
2	Arginine	..	..	+	..	2+	..	2+	..	+
3	Aspartic acid	..	..	3+	..	2+	+	3+	..	2+
4	Glutamic acid	..	..	3+	+	2+	+	2+	..	+
5	Glycine	..	+	2+	+	2+	+	2+	..	2+
6	Histidine	..	..	+	..	..	..	..	..	..
7	Isoleucine	..	..	2+	2+	+	+	2+	..	+
8	Leucine	..	+	2+	2+	+	+	3+	..	+
9	Lysine	..	..	2+	+	+	..	2+	..	+
10	Methionine	..	+	2+	2+	2+	+	3+	..	+
11	Phenyl alanine	..	..	2+	+	+	..	+	..	..
12	Proline	..	..	+	..	+	..	..	..	..
13	Serine	..	..	2+	..	2+	+	2+	..	+
14	Threonine	..	+	3+	+	2+	..	2+	..	+
15	Tryptophan	..	..	Trace	..	Trace	..	Trace	..	Trace
16	Tyrosine	..	..	2+	..	Trace	..	+	+	Trace
17	Valine	..	..	+	..	Trace	..	+	..	..
18	Unidentified ²	..	..	+	..	+	..	+	..	+

* Each + indicates about 3 mg. % of the dry lichen.

† Each + indicates about 200 mg. % of the dry lichen.